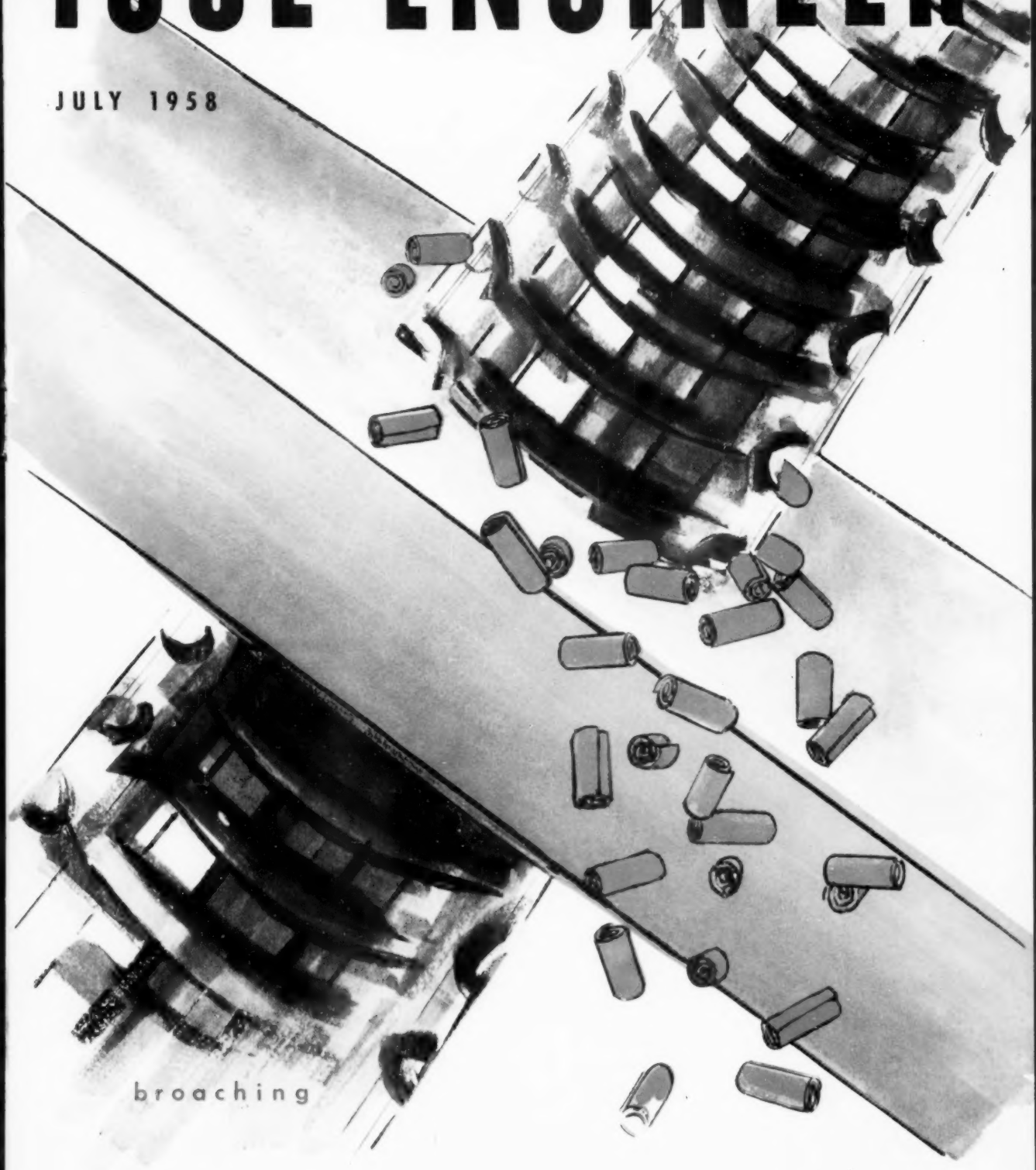
the

TOOL ENGINEER

JULY 1958



broaching

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

it's mainly a matter of TIMING!

Knowing WHEN to replace a machine saved one manufacturer $16,794 a year

TAKE ANY machine in your plant. You know that some day it will have to be replaced. But *when?* That is the big question. And wrong answers probably cost American Industry millions of dollars every year.

For any machine, there is one optimum replacement time—the time when it can be replaced with a new one at *lowest overall cost.* And it can't be determined by haphazard methods. Guesswork, intuition or rule-of-thumb computations will be wrong most of the time. And even some obsolescence formulas are not above suspicion. But you can put a dollar sign on every variable involved, and come up with a precise figure that will mean a major saving in production cost and capital investment.

Heald sales engineers are well experienced in making obsolescence studies to determine when a machine should be replaced. Sometimes it is found that replacement is overdue. And often it can be shown that next year or the year after would be better for the customer. If you would like help in planning your replacement program, or want to confirm your estimates for a particular machine, just call in your Heald engineer. Similar studies have pointed the way to many important savings.

For Example: A manufacturer of aircraft instruments had been using a 5-year-old precision lathe to perform boring, turning and facing operations on instrument cases. But when this was replaced with a new Heald Model 0 Unit-Type Bore-Matic like that shown at the right, operating costs for the same production were immediately reduced by over 78%. In addition, the elimination of a separate burring operation and reduced assembly time made further important savings, as indicated by the cost analysis below.

	Old Machine	New Machine
Parts per hour	4.3	20
Parts per year (Req'd. Prod.)	10,000	10,000
Direct and Indirect Labor, per year	$20,349	$ 6,055
Scrap Losses, per year	$ 500	$ 300
Annual Maintenance Cost	$ 600	$ 300
Annual Operating Cost	$21,449	$ 6,655
Basic Annual Saving, New Machine		$14,794
Additional Saving from elimination of separate operation		$ 500
Additional Saving from reduced assembly time		$ 1,500
Total Saving Per Year		$16,794
Return on Investment for New Machine		84%

YOU pay for obsolescence. Replacement pays for itself!

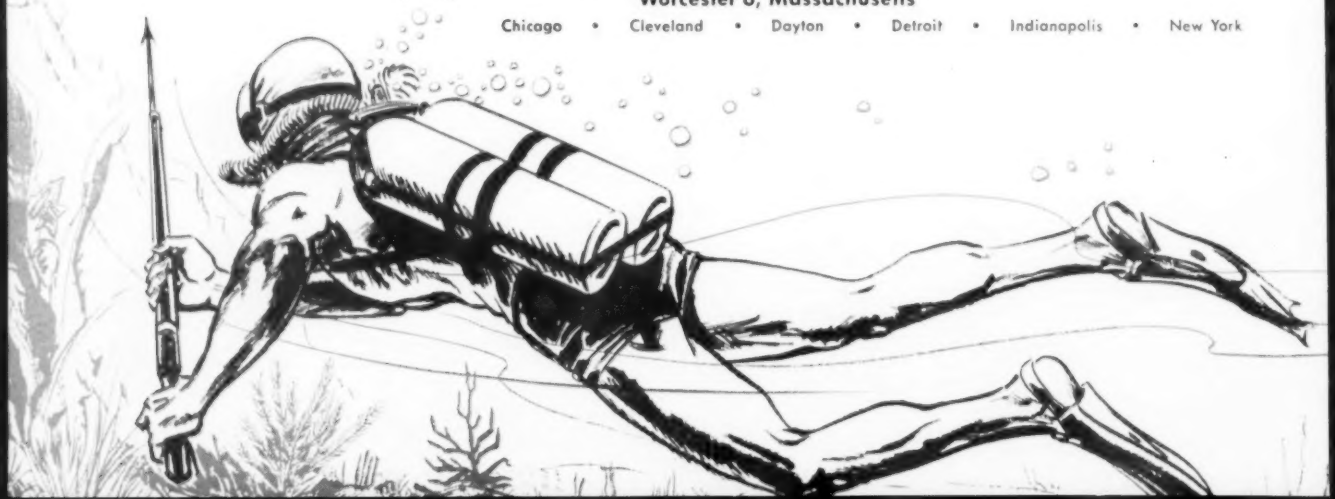
THE **HEALD** MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

HEALD ®



the tool engineer

Vol. 41, No. 1 July 1958

THIS MONTH'S COVER

Broaching of small precision parts has saved time and money at IBM's Poughkeepsie plant. Cover artist William Solms has depicted a typical internal broaching operation. Grooves on the ID of a hole are accurately cut in one pass. Other operations are covered in an article beginning on page 81.

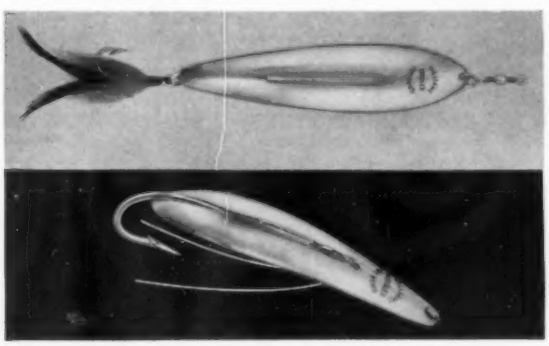
THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Industrial Arts Index.*

NEW BRASS
CUTS POLISHING COST

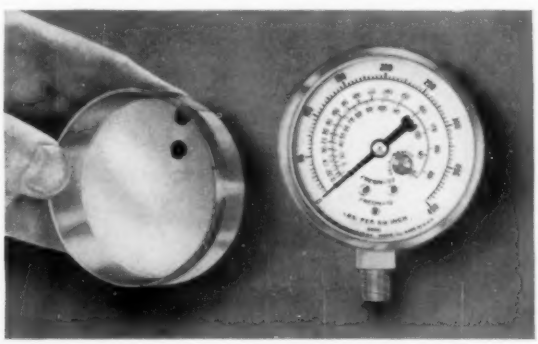
also gives you clean, easy drawing and forming, plus higher physical properties—Formbrite,® Superfine-Grain Drawing Brass by Anaconda

AIRGUIDE Instrument Co., Chicago, gets high luster finish on bezels for its famous weather instruments at 50% lower cost since it switched from ordinary drawing brass to Formbrite. Airguide does the presswork—says Formbrite "draws and forms excellently." Driscoll & Co. (above) polishes the bezels.

BAROMETER in Chippendale style, "Mayfair," is one of the broad line of brass-trimmed instruments made for home and marine use by Airguide.



FISHING LURES made by Williams Gold Refining Co., Inc.—"Wabler," top and "Weedler," below—are polished for plating by tumbling. Switching from ordinary yellow brass to Formbrite cut costs more than 40%.



MARSH Instrument Co., Skokie, Ill., dropped a finishing operation and gets a "mirror finish" with a light buff, by using Formbrite. Marsh reports that finishing cost was cut 40% and that forming is "excellent."

Wherever finishing is an important cost factor in formed or drawn products, Formbrite in sheet and strip is designed to save you money. In brass wire alloys for cold-heading and upsetting, it gives a stronger, springier, more abrasion-resistant product. For more detailed information, write for Publication B-39. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5843

FORMBRITE

SUPERFINE-GRAIN DRAWING BRASS

a product of

ANACONDA®

Made by The American Brass Company

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Another Useful Tool

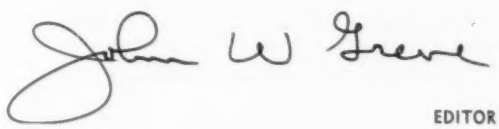
"Atoms for Peace" program has resulted in the dedication of the world's first full-scale atomic power station at Shippingport, Pennsylvania. Not particularly large, when compared with conventional stations, it produces more electricity than any other individual reactor in existence. Its 60,000 kilowatts helps carry the industrial, commercial and residential load in Pittsburgh.

As an industrial tool, atomic power simplifies the considerations for choosing a plant site. Insofar as primary power is concerned, proximity to water and conventional fuels are of little concern. Materials supply and other factors become the chief considerations of location.

Developed principally as a pilot laboratory, Shippingport will supply little information on power costs and other economic data. It will, however, demonstrate the feasibility and practicability of dependable and safe power generation. Every known safety precaution is employed and elaborate facilities are installed to study the many aspects of operating a nuclear reactor of this size on a continuous schedule and upon a commercial scale.

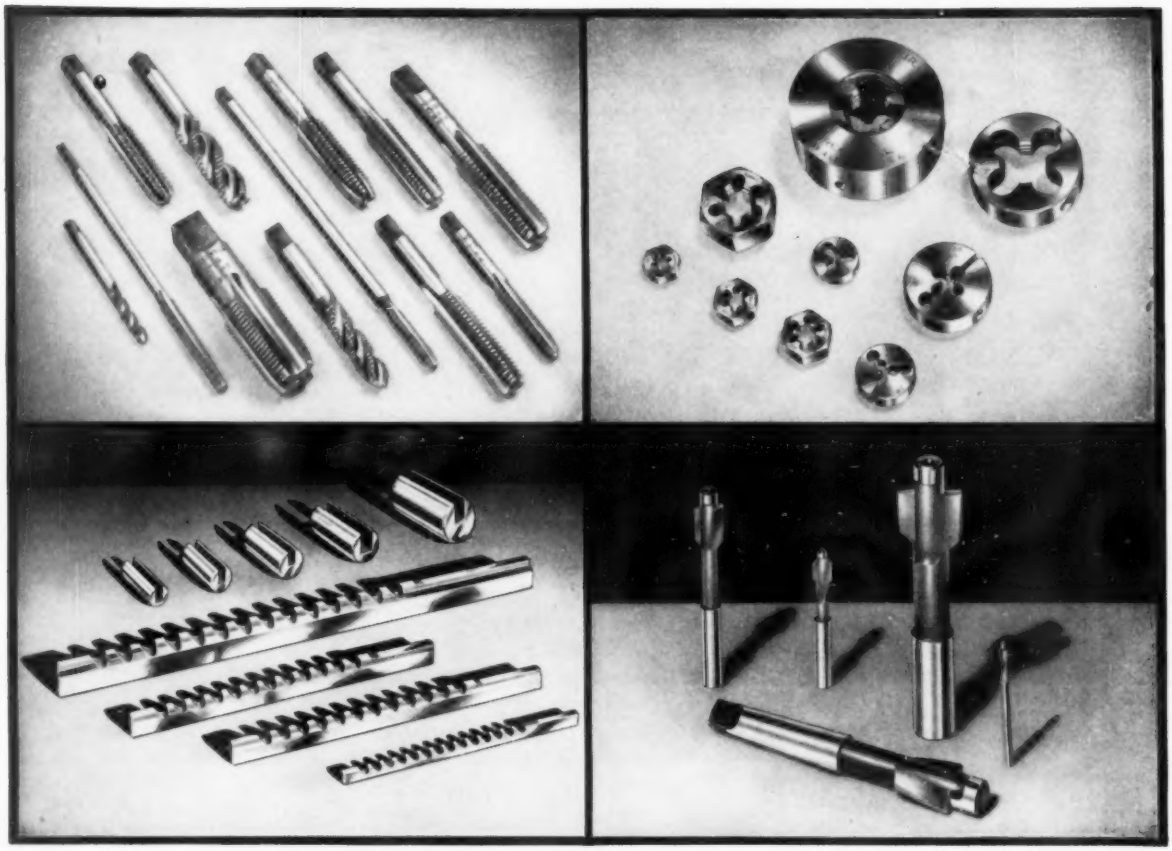
The Shippingport station is jointly owned by the U. S. Atomic Energy Commission and Duquesne Light Co. Westinghouse Electric Corp. designed and developed the nuclear portion of the plant. It is a water-pressurized system.

During the dedication ceremony Admiral Rickover observed that previously man was required to accommodate himself to his environment. Now, he can control that environment. God grant that he may use that power wisely for the benefit of mankind.



EDITOR

THREADWELL CUTTING TOOLS



FOR EVERY APPLICATION

Regardless of application Threadwell has the right cutting tools for the right job. Proof of their superior quality and accuracy is evidenced in their performance. Why not experience the confidence all Threadwell users enjoy and include Threadwell in your production plans . . . now.

See your Threadwell distributor
for the finest in Taps, Dies, Counterbores,
Keyway Broaches *and Gages.*

Threadwell

THREADWELL TAP & DIE COMPANY
Greenfield, Mass., U.S.A.

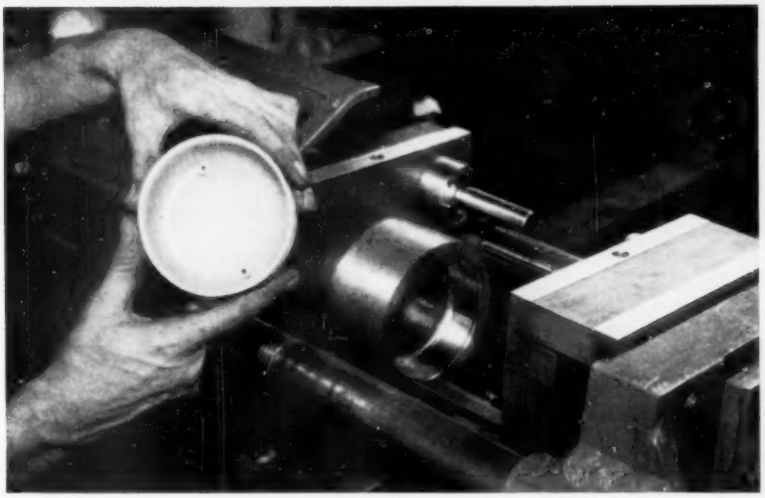
Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributors: Bethlehem Steel Export Corporation

Lustre-Die held costs down in molding plastic covers



"We need," said the customer, "a plastic cover to protect our sealed motors. It's to be drip-proof and sturdy, yet must be a low cost item. Do you have a grade of die steel which will help us produce such a cover economically?"

The mold maker, Dollins Tool & Gage Co., Independence, Mo., put the problem up to Ford Steel Co., St. Louis, our local tool steel distributor. Quick as a flash came their recommendation: "Lustre-Die!"

The electric-furnace steel performed to everyone's satisfaction. It was economical. It took a high polish. It had high compressive strength. It machined easily. It performed well in molding the parts which were held to a close tolerance of .001 in.

Lustre-Die is just the ticket for molding plastics because its properties make possible a bright, mirror-like polish. Lustre-Die has the proper basic analysis for molding plastics. And it offers something more — alloy fortification! Lustre-Die is heat-treated by oil-quenching and tempering to augment its properties, and is furnished ready for machining and polishing.

Lustre-Die is carefully inspected to insure cleanliness. It is free from injurious porosity or surface pitting. And there's no problem about inclusion-causing additions.

Lustre-Die is a good steel to keep in mind for your next plastic-molding operation. Your Bethlehem tool steel distributor can furnish it from stock. Why not give him a call?

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Here's Why Air-Hardening Steels are Good Performers

When a large group of various types of tools made from air-hardening tool steels is compared with a group of similar tools made from steels which require liquid quenching for hardening, it will be found that the air-hardened tools outperform the liquid-quenched tools in service. This result will not necessarily be found in the comparison of individual tools, but will appear if a large enough variety and number of tools are studied.

The reason why air-hardened tools outperform liquid-quenched tools can be summed up in one word — consistency. The consistent performance of air-hardened tools is evident in many ways:

DIMENSIONAL STABILITY

All tools, when subjected to the hardening operation, develop small but measurable dimensional changes (so-called distortion). Air-hardened tools not only show less dimensional change than liquid-quenched tools, but the changes that do occur are remarkably similar in each tool when identical tools are made up. By contrast, liquid-hardened tools show considerably more variation from tool to tool when identical tools are produced.

HARDNESS

Duplicate air-hardened tools invariably show the same hardness after heat-treatment. Liquid-quenched tools may show erratic hardness in various locations on a tool, due to variations in effectiveness of the liquid quench; however, duplicate tools will each have a somewhat different hardness pattern.

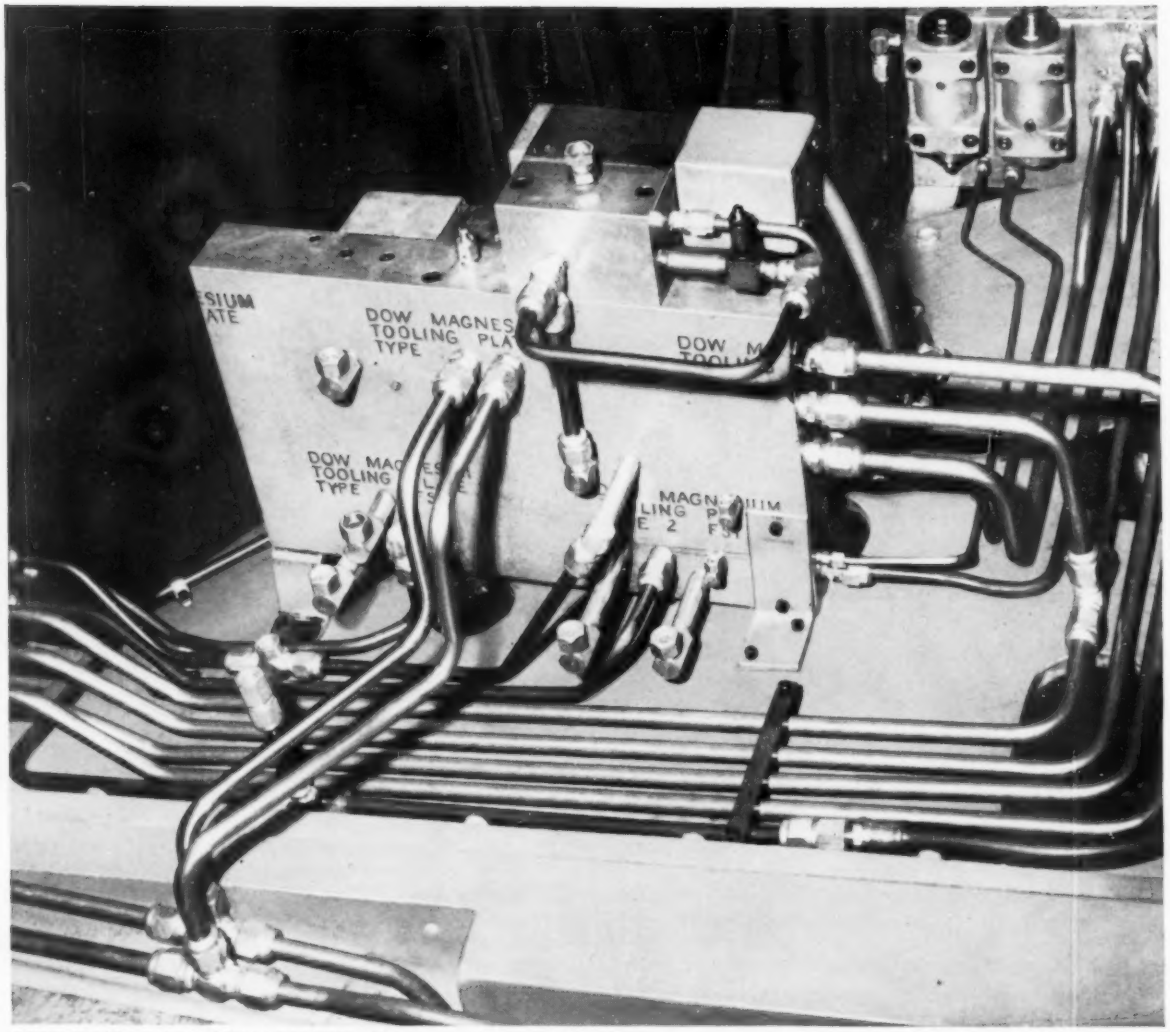
RESIDUAL QUENCHING STRESSES

All tools develop residual internal stresses due to the hardening operation. Liquid-quenched tools develop high internal residual stresses because of the variations in cooling rate which occur in different locations on a tool during the quench. If improperly controlled, these stresses can lead to cracking of the tools in heat-treatment or in grinding, or the load-carrying ability of the tools may be low and erratic.

By contrast, air-hardened tools develop only a low degree of internal stress during hardening, because of the comparatively uniform cooling in the quench. Furthermore, the degree of internal stress which develops is uniform from tool to tool, so that the service performance of duplicate tools is reasonably consistent.

The advantages of air-hardening steels cannot be realized, however, unless they are hardened by air-quenching. It is possible to harden all air-hardening steels by liquid-quenching (oil-quench or salt-quench as in martempering) and this is frequently done because of the convenience of existing heat-treatment equipment. However, liquid-quenching of air-hardening steels is a serious mistake, because it sacrifices almost all the basic advantages of air-hardening steels. Liquid-quenching not only increases distortion and internal stresses, but may lead to cracking of some of the tools during heat-treatment. Air-hardened steels which are properly quenched in air do not crack in heat-treatment.

Bethlehem offers a full range of air-hardening steels: Bearcat for shock applications, A-H5 for general-purpose tool and die work, and Lehigh H for maximum production runs.



EXCELLENT MACHINABILITY *of Dow magnesium tooling plate permits economies in drilling the necessary holes (approximately 100) in this 20" x 12" block.*

"ROCKFORD" SAVES 20% ON MATERIAL COSTS WITH DOW MAGNESIUM TOOLING PLATE

The many advantages of Dow magnesium tooling plate are put to use in building control panels for hydraulic planers. Rockford Machine Tool Company of Rockford, Illinois, realized a 20% savings on material costs alone by using magnesium rather than other lightweight tooling metals!

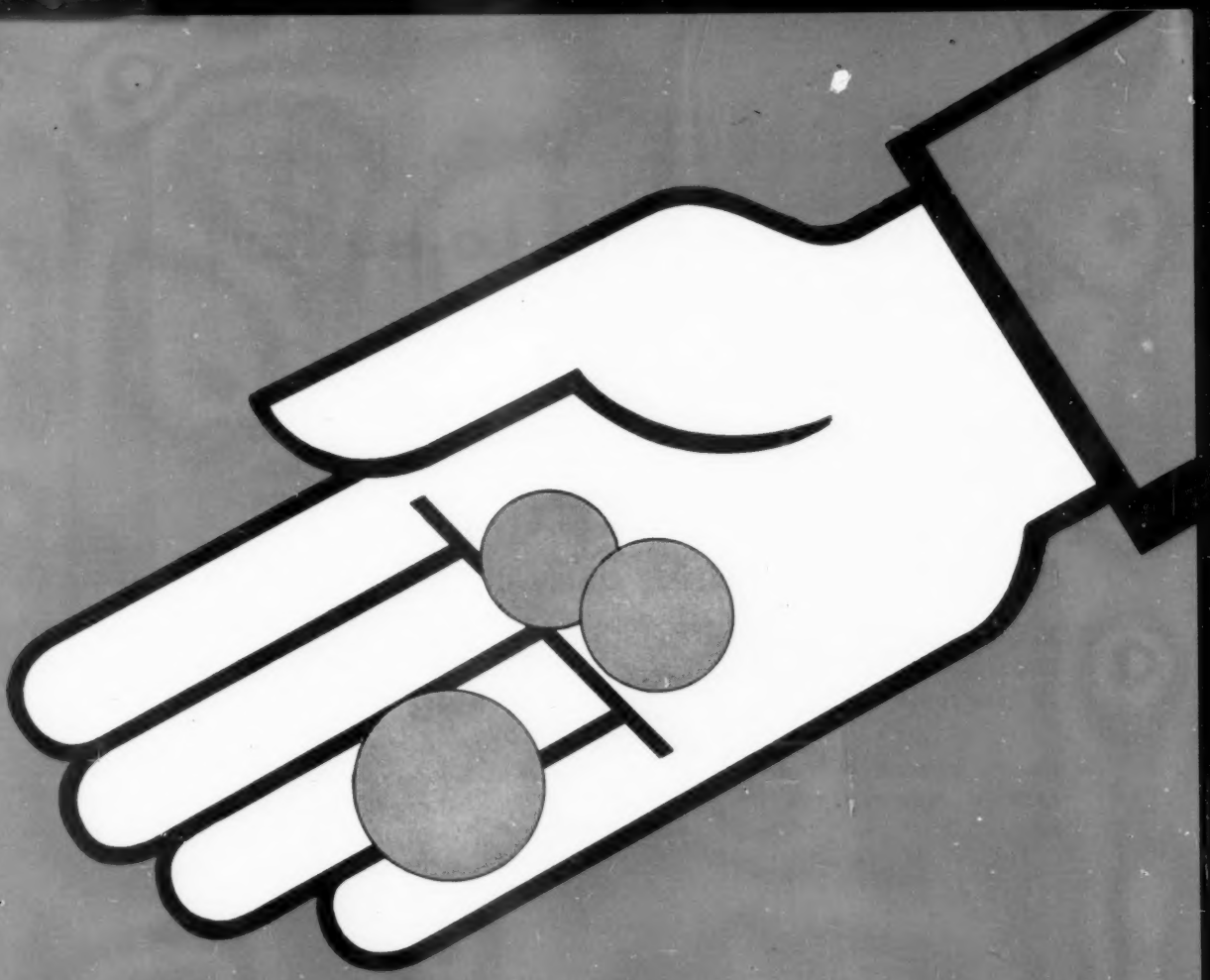
But the savings don't stop with the original purchase cost when you use Dow magnesium tooling plate. You actually save *twice:* once when you buy it and again when you use it. That's because magnesium is the easiest of all metals to machine—takes less time and less wear on tools to do the job. Magnesium tooling plate requires less machining because new closer tolerances assure better flatness and dimensional accuracy.

Next time you need a tooling metal try magnesium. You, too, will find it saves time, effort and money. Get in touch with one of the Dow magnesium suppliers listed below, or write us for more information. THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1431A.

AVAILABLE FROM STOCK AT

COPPER AND BRASS SALES, Detroit, Michigan
FULLERTON STEEL AND WIRE CO., Chicago, Illinois
HUBBELL METALS INC., St. Louis, Missouri
A. R. PURDY CO., INC., Lyndhurst, New Jersey
RELIANCE MAGNESIUM COMPANY, Los Angeles, California
VINSON STEEL AND ALUMINUM COMPANY, Dallas, Texas.

YOU CAN DEPEND ON DOW



Still handing out pensions to obsolete machines?

Talk to

Snyder

TOOL AND ENGINEERING COMPANY

3400 E. Lafayette, Detroit 7, Michigan

Special Machine Tools with Automation for More Than 30 Years

double value

from "DOUBLE LO-HUNG" SPINDLE DRIVE . . .

"AMERICAN" Hole Wizards Provide:

1. ***High spindle speeds at low gear velocities.***
2. ***Heavy drilling, boring and large tapping speeds at low tooth pressures.***
3. ***Faster tapping through spindle reverse speed-up.***

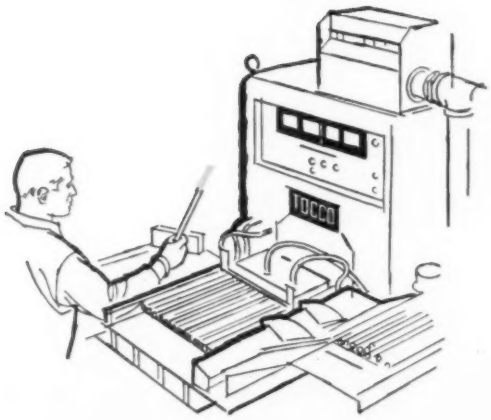
The "Double Lo-Hung" Spindle Drive is an exclusive "AMERICAN" Hole Wizard feature. This drive divides the speed range into two separate ranges; the high speeds through a small gear to minimize gear velocities; the low speeds through a large gear to reduce gear tooth pressures under severe service.

This design in combination with its nitrided Spindle and Sleeve, Timken Mounted with outside adjustment for Spindle Bearings, guarantees maximum life, dependable operation and spindle stability for "AMERICAN" Hole Wizards unequalled by other designs.

• ***Bulletin No. 328 tells the story***

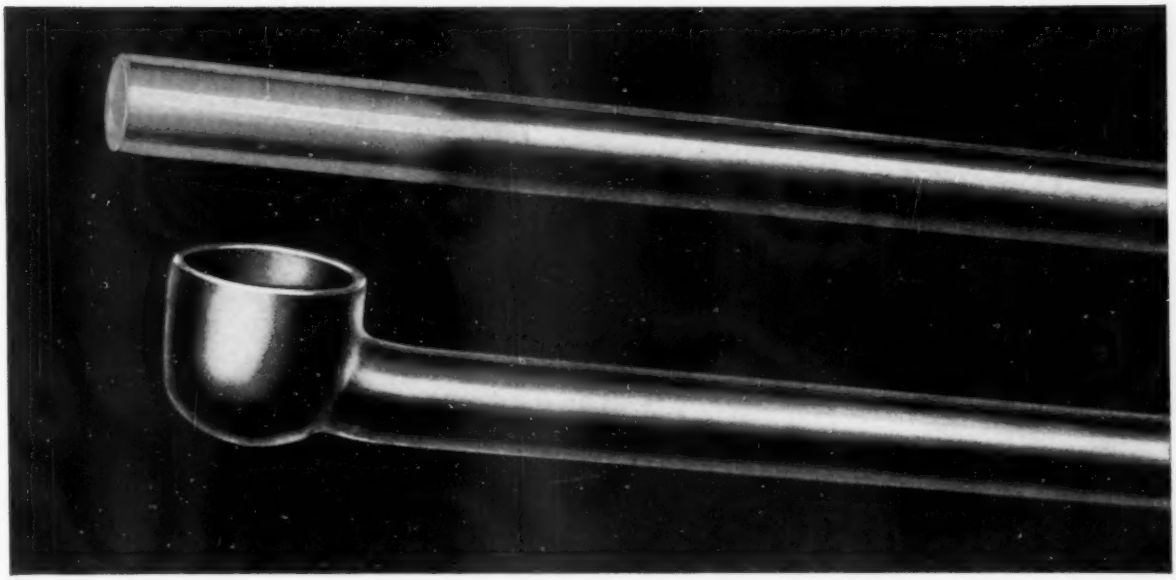
THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS



Heating Costs Cut In Half

with TOCCO* *Induction Heating*



Engineers at Thompson Products Inc.'s Michigan Division recently changed from gas-fired furnaces to fully automatic TOCCO. Application: heating for forging of automotive tie rods. Result: a substantial reduction in direct labor costs, saving thousands of dollars a year on this heating for forging operation. *Annual savings actually amortize the cost of the TOCCO installation in about one year.*

The automotive tie rod shown here is only one of over 500 parts heated for forging in Thompson's new, modern forge plant. *Every one of these parts is heated with TOCCO equipment.*

If *your* manufacturing operations require heating for forging, heat treating, brazing, soldering or melting, it will pay you to investigate TOCCO as a sound method of increasing production and lowering costs.

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today—NEW FREE Bulletin

The Ohio Crankshaft Co. • Dept. G-7, Cleveland 5, Ohio

Please send copy of "Typical Results of TOCCO Induction Heating for Forging and Forming".

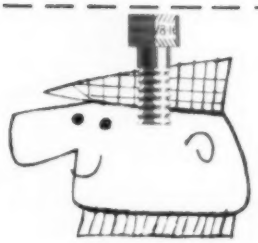
Name_____

Position_____

Company_____

Address_____

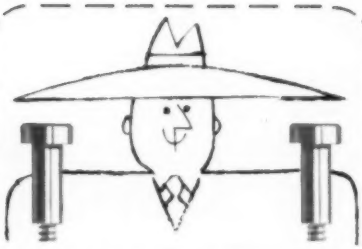
City_____ Zone____ State_____



CAP SCREWS

keep your cap on tight.

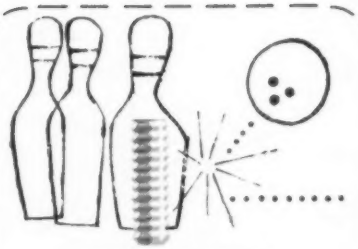
Owners of Thunderbirds, Corvettes and other snazzy top-down convertibles, tell us our special alloy and stainless steel P-K SOCKET HEAD CAP SCREWS do a mighty fine job of keeping their caps on. Naturally they specify PARKER-KALON, because they know P-Ks are instrument tested and inspected at every step of manufacture.



SHOULDER SCREWS

keep shoulders from sagging.

Used on either shoulder, or preferably both, P-K SHOULDER SCREWS will make you stand straighter, look better, may even result in getting you a substantial raise. Dependable, too. Heads are concentric with body for uniform, accurate assembly. Finished threads are close to shoulder for maximum holding power. And P-K SHOULDER SCREWS are accurate for positive internal wrenching and non-slip drive.



SET SCREWS

help make your score look good.

When the pin boy sets the pins for your opponent, he inserts a P-K SOCKET SET SCREW. Nobody'll know what's happening. Even a perfectly placed ball won't budge the pins as those P-K Set Screws hold them firmly to the floor. Same fine job in your plant, too. Use a P-K Cup Point for collars on pulleys and shafts, P-K Flat Point against hardened steel, and there's a selection of P-K Oval, Cone and Half-Dog Points from which to choose.

BUTTON HEADS

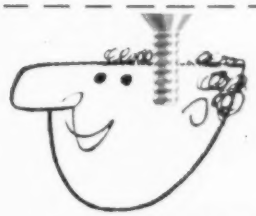
for you know who . . .

Take that neighbor who borrows your tools and never returns them. You can't openly call him names—his wife and yours are PTA buddies. So, just place a few Button Heads around his doorstep. He'll get the idea. And don't forget, you can also use P-K BUTTON HEAD CAP SCREWS for attaching cover plates and guards to production equipment and machine tools where countersinking isn't practical.

guide to

P-K®

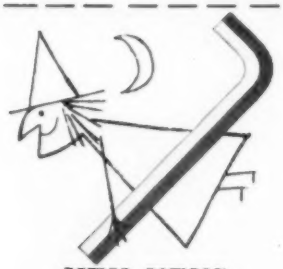
SOCKET SCREWS



FLAT HEADS

for that well-groomed look.

Holes in the head are apt to cause talk. Especially where the top of the noggin tends to be flat and somewhat bald. Users can remove hats without embarrassment. P-K FLAT HEAD SOCKET CAP SCREWS are flush when countersunk, leaving smooth surfaces unmarred by burred slots. Use for fastening thin strips, moldings, plates and sheet metal where maximum head contact is required.



HEX KEYS

for putting a hex on people.

Persons planning the quiet disappearance of friends or neighbors, or merely interested in more productive shop practices, should always remember to specify P-K ENGINEERED HEX KEYS. They're heat treated under laboratory supervision to assure maximum resistance to torque stresses and freedom from brittleness. And come in handy for tightening those mighty fine socket screws offered by Parker-Kalon.

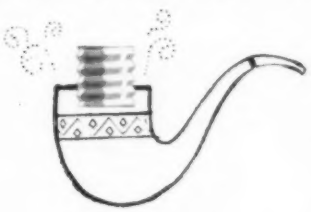
Like a copy of this guide for your office? We'll be glad to send a reprint suitable for framing.

PARKER-KALON®
SOCKET SCREWS

Sold only through industrial supply distributors

PARKER-KALON DIVISION, General American Transportation Corporation, Clifton, N. J.

Originators of the Self-tapping Screw; Manufacturers of Screw Nails, Masonry Nails, Wing Nuts, Thumb Screws and the new Rimguard Weld Screws.

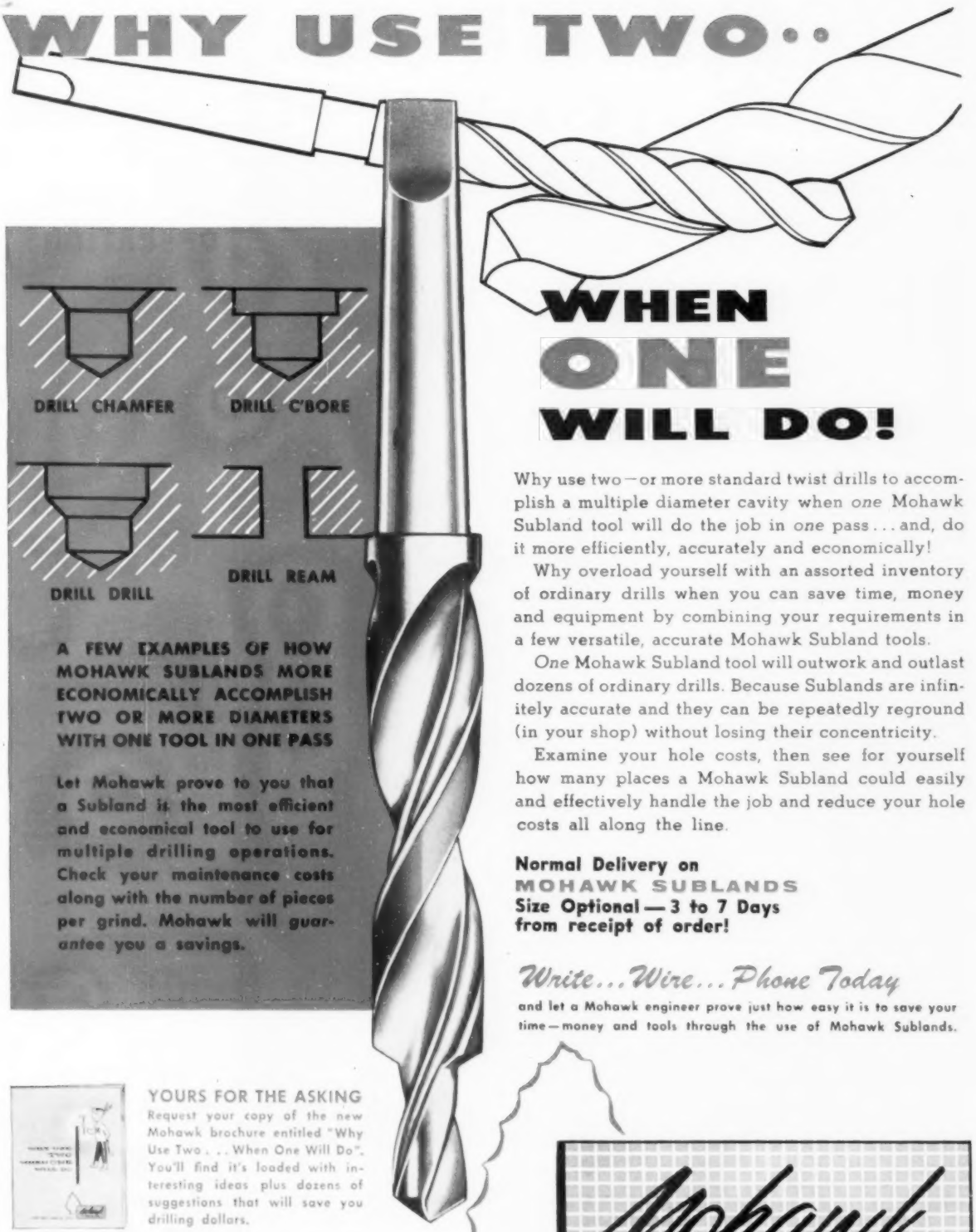


PIPE PLUGS

. . . just dandy for that old pipe.

P-K SOCKET PIPE PLUGS are the perfect answer whenever smoke gets kinda thick in the house and the little woman starts to get that look on her face. Drive one firmly into the bowl of your favorite pipe. No smoke escapes and all is peaceful. Examine a P-K Pipe Plug. Controlled chamfer makes for fast starting of threads. And P-Ks *Dryseal* produces a positive sealing without the necessity of a compound.

WHY USE TWO··



A FEW EXAMPLES OF HOW MOHAWK SUBLANDS MORE ECONOMICALLY ACCOMPLISH TWO OR MORE DIAMETERS WITH ONE TOOL IN ONE PASS

Let Mohawk prove to you that a Subland is the most efficient and economical tool to use for multiple drilling operations. Check your maintenance costs along with the number of pieces per grind. Mohawk will guarantee you a savings.

WHEN ONE WILL DO!

Why use two—or more standard twist drills to accomplish a multiple diameter cavity when *one* Mohawk Subland tool will do the job in *one* pass . . . and, do it more efficiently, accurately and economically!

Why overload yourself with an assorted inventory of ordinary drills when you can save time, money and equipment by combining your requirements in a few versatile, accurate Mohawk Subland tools.

One Mohawk Subland tool will outwork and outlast dozens of ordinary drills. Because Sublands are infinitely accurate and they can be repeatedly reground (in your shop) without losing their concentricity.

Examine your hole costs, then see for yourself how many places a Mohawk Subland could easily and effectively handle the job and reduce your hole costs all along the line.

Normal Delivery on
MOHAWK SUBLANDS
Size Optional — 3 to 7 Days from receipt of order!

Write . . . Wire . . . Phone Today

and let a Mohawk engineer prove just how easy it is to save your time—money and tools through the use of Mohawk Sublands.

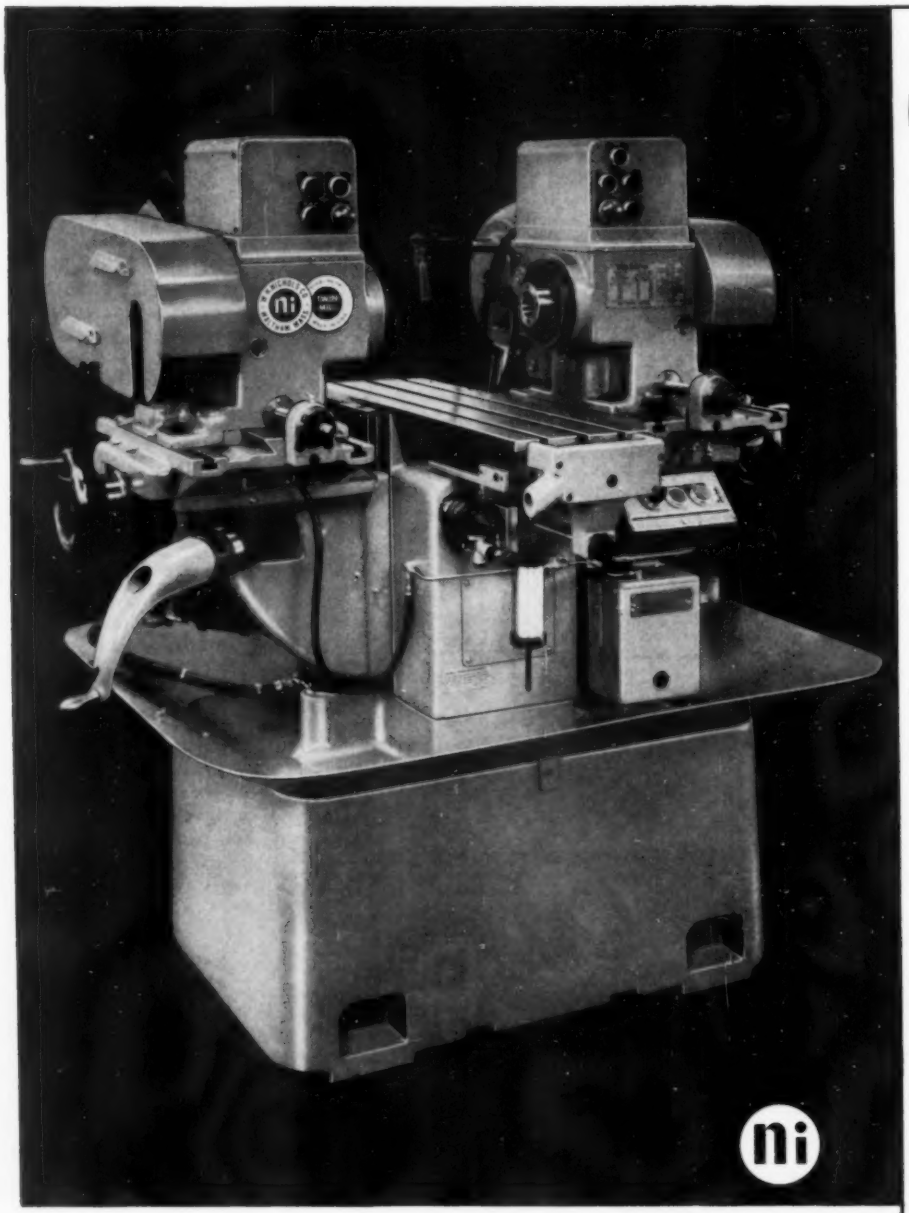
YOURS FOR THE ASKING

Request your copy of the new Mohawk brochure entitled "Why Use Two . . . When One Will Do". You'll find it's loaded with interesting ideas plus dozens of suggestions that will save you drilling dollars.

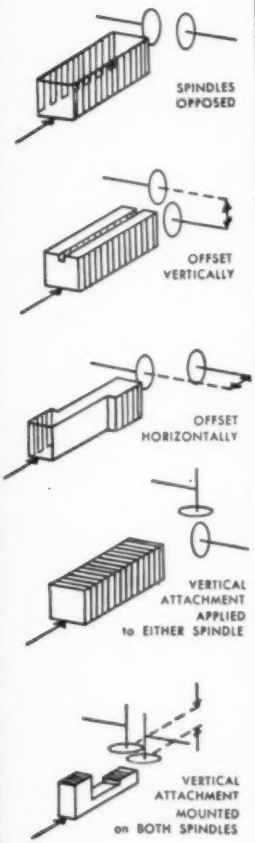
world's largest producers of Sublands

Mohawk TOOLS, Inc.
Montpelier, Ohio

NICHOLS TWIN MILL FOR THE GREATEST VERSATILITY PER DOLLAR



ALL THESE OPERATIONS



AT THIS LOW COST

$7,260

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Precision Tool News

NO. 6 REPORTING NEW DEVELOPMENTS AT BROWN & SHARPE'S PRECISION CENTER

New B & S Convertible Thimble Micrometer Changes to Either "Friction" or "Fixed" Type in a Second

The simple twist of a "friction control" sets the advanced new Brown & Sharpe Convertible Thimble Micrometer for *either:* (1) "Friction" action (friction sleeve slips on thimble when proper measuring pressure has been reached) *or* (2) "Fixed" action (with sleeve locked to thimble). Thus the B & S Convertible Thimble Micrometer suits any user, whether he prefers to get a uniform "miking" pressure automatically, or "by feel".

Offers Features For Easy One-Hand Operation

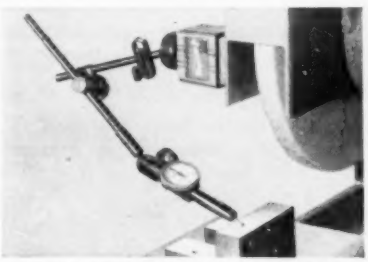
Placement of the friction sleeve within easy reach and a new lever-type lock on the new B&S micrometer provide true "fingertip" control . . . make it an easy mike to use in one hand . . . even a small hand. Other features: floating lock will not misalign spindle; *oblique barrel graduations* are easy to read . . . warn user what reading he is approaching; wide-spaced, numbered thimble divisions and pleasing, dull-chrome finish, aid positive reading; simple zero setting and wear adjustments included; carbide measuring faces assure long wear. *Range: 0-1", in .0001". Order: Brown & Sharpe Convertible Thimble Micrometer, Friction Type, No. 1011.*

Personalized with Owner's Initials at No Extra Cost

B&S Convertible Thimble Micrometers can be "personalized" with up to 3 initials at no extra charge. Identifies the micrometer as your own, prevents loss.

New Devices Simplify Setting of B & S Dial Bore Gages with Jo-Block Precision

Brown & Sharpe Adjustable Bore Gage Setting Devices provide a quick method for setting B&S Dial Bore Gages. Have built-in centralizing rails which reduce manipulation. Set once to gage blocks, they are kept "on the job" for frequent, highly-accurate checks of the gage . . . eliminate the need for inventories of ring gages.



B & S Magnicator Jr. Holds Small Tools Almost Anywhere Without Clamping

Brown & Sharpe's inexpensive Magnicator Jr. is used with B&S dial indicators, lights, magnifiers and other accessories to make inspection and setup work easier. A strong permanent magnet in the base anchors it firmly to any ferrous metal. A larger, heavy-duty "Magnicator" model, with releasing lever, is also available.

Brown & Sharpe precision tools are available to you quickly, at factory prices, through your nearby B&S distributor. Brown & Sharpe Mfg. Co., Providence 1, R. I.

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For steelcutting . . . trim costs with Carboloy® Extra-Performance Grades 330, 350, and 370, and low-cost, General-Purpose Carboloy 78 and 78B carbides

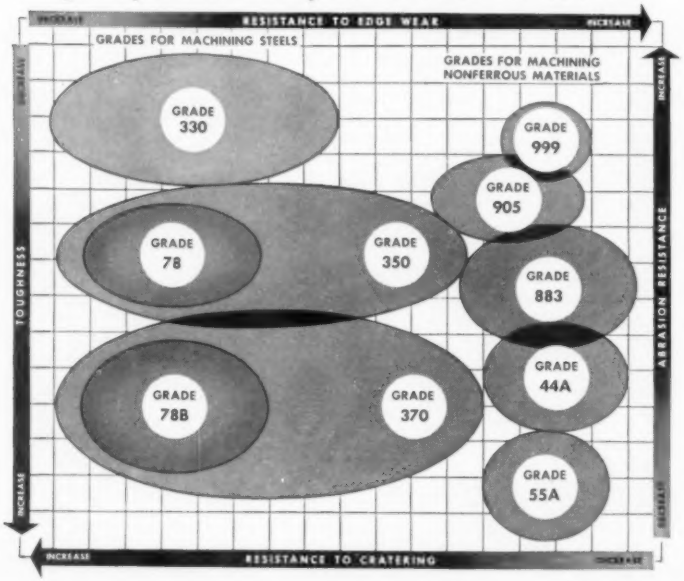
Some steelcutting jobs call for extra-tough, extra-performance carbides. Others can only be handled profitably with low-cost, general-purpose carbides. That's why we make them *both*.

Where you need increased machine productivity and have long production runs to keep cost-per-piece low—use Carboloy Extra-Performance Series 300 carbides. Their added strength and stamina handle jobs ranging from heavy roughing to high-speed finishing . . . at a unit cost and rate no "premium" carbide on the market can beat.

But, for general-purpose steelcutting jobs that don't require the Extra-Performance carbides, use Carboloy Grades 78 and 78B. Their top-notch performance, at low initial tool cost, will keep your machines operating profitably.

Chances are, your plant should be using *both* grades. Your local Authorized Distributor of Carboloy cemented carbides can deliver tools, blanks and inserts you need . . . in a hurry.

This complete team of Carboloy cemented carbides gives you more for your carbide tool dollar!



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For nonferrous materials . . . boost production rates with Carboloy® cemented carbides performance-matched to your machining jobs

Aluminum, titanium, super alloys, wood—all have machining peculiarities that raise cain with production schedules and tool costs. That's why we make *five* job-tailored Carboloy cemented carbides for cutting these materials.

With these five grades (see chart, at left), you can get the one with exactly the right combination of shock resistance and wear resistance to match your job—whether heavy, interrupted cuts, or precision finishing.

Because you're using performance-matched carbides with consistent metallurgical quality, you can schedule heavier production loads . . . and you will get this increased output at lower tool-cost-per-piece.

Your local Authorized Carboloy Distributor has complete stocks of tools, blanks, and inserts in these five grades. A phone call to him today will get your machines humming faster tomorrow.

For more information on Carboloy Extra-Performance and General-Purpose carbides, or nonferrous material carbides, write: Metallurgical Products Department of General Electric Company, 11101 E. 8 Mile Road, Detroit 32, Michigan.

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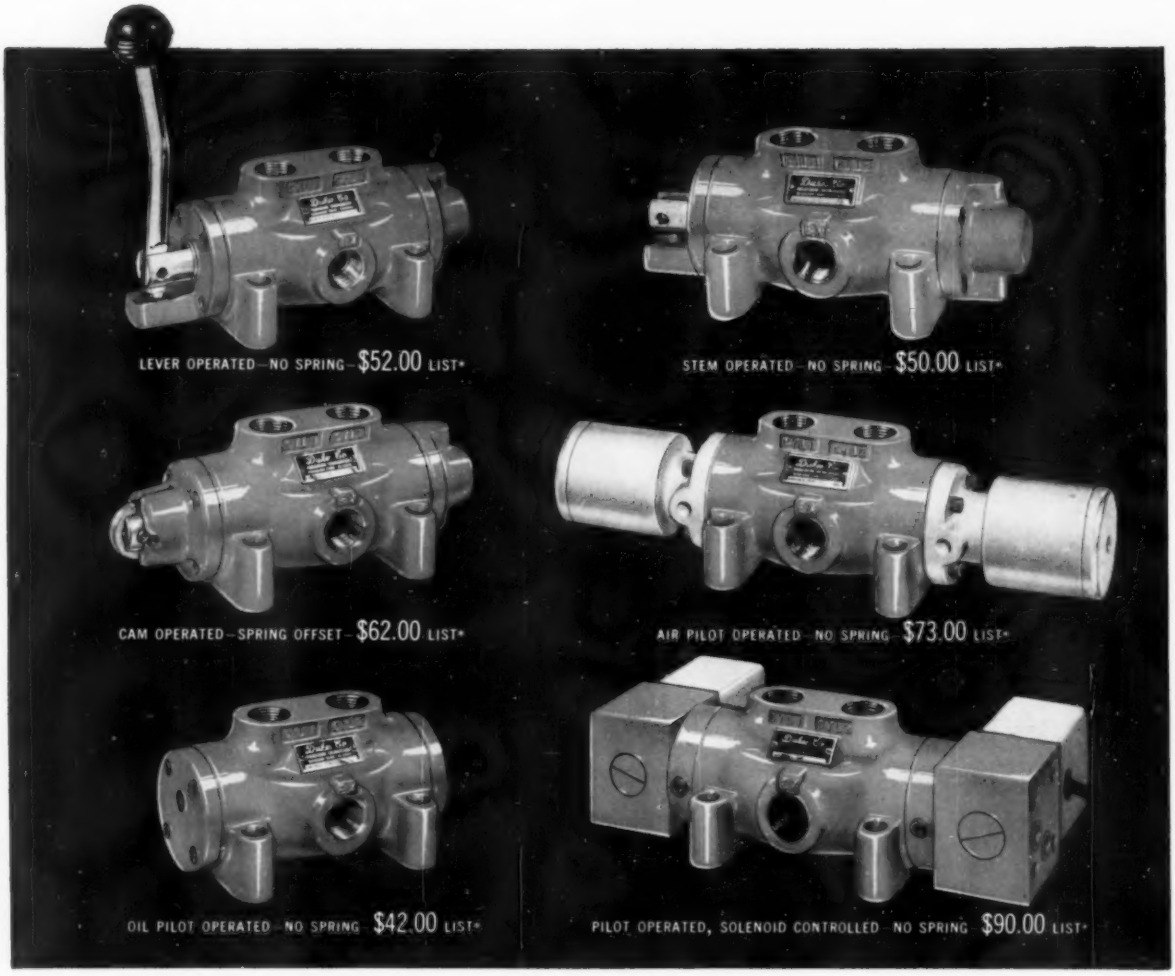

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More cost-cutting IDEAS— to help you

HOW DeLAVAL SAVES 383 MINUTES ON PROBLEM PART

Automatic and turret lathes team up with JETracer equipment for large workpieces

If you can apply this basic idea to your work, you're due for big savings. At the DeLaval Company's Poughkeepsie, New York, plant it cut former machining time 70% and eliminated a 1½-hour polishing job.

The workpieces are separator bowl shells of tough 302 stainless. The parts are rough-machined on two Gisholt No. 24 Automatic Production Lathes with JETracer-equipment. They are finished on two 3L Saddle Type Turret Lathes—each equipped with two JETracer slide tools mounted on the hexagon turret. Each JETracer slide tool is an independent unit with its own overhead sliding template carrier that locates for length from an adjustable bracket on the overhead pilot bar. Forward feed of the turret saddle causes the tracer stylus to follow the template contour, reproducing the form in the workpiece. The entire assembly indexes with the turret and does not restrict the use of other tooling.

A variable-speed, constant-h.p. (30) drive motor is used. An indexing speed template, at the rear of the turret carriage, indexes with the turret and provides a constant cutting speed when either JETracer slide is used, without stopping the spindle or removing the tool from the cut.

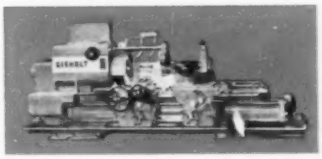
Finish Operation 1 on 3L

A 21″ chuck holds at Y, locates at X. Hex 1 tools rough F, rough-bore O. Hex 2 traces sections M-H-D. Tool post tools face B-J, turn K. Hex 3 finish-turns F. Hex 4 chamfers N and A is turned from the tool post. Hex 5 traces section C. Tool post tools chamfer B-G-L and F is finish-turned from hex 6. F.t.f. time, only 70 minutes.

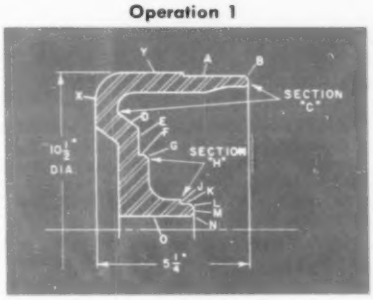
Finish Operation 2 on 3L

The workpiece is hand-clamped at S, centralized at X and located at Y for the second operation. Hex 2 stepbores O, and tool post tools rough-face Q in two passes and finish-taperbore O in three passes, using the taper attachment on the square turret carriage. Hex 3 is open. Section P is traced from hex 4. The spindle is then stopped; an air-operated clamp is inserted, holding at Q; hand clamps are removed from S, and section R is traced from hex 1 to complete the part. Time, f.t.f., 30 minutes.

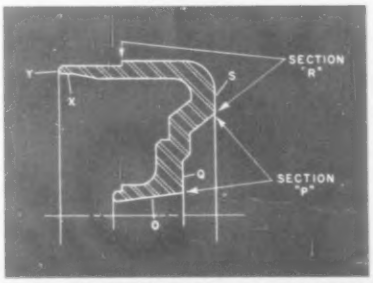
JETracer, using inexpensive single-point tools, machines complicated surfaces accurately, holding bores to .0008″, diameters to .0008″, depths to .004″. Combined No. 24-3L setup completes part in 167 minutes, saving 383 minutes over previous methods. 20 micro-inch RMS finish is obtained, saving a 1½-hour polishing operation.



Operation 1

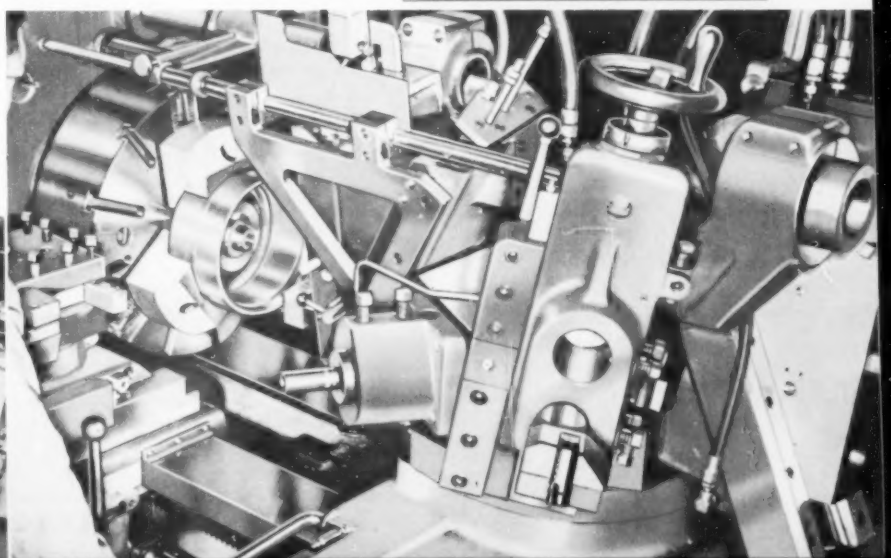


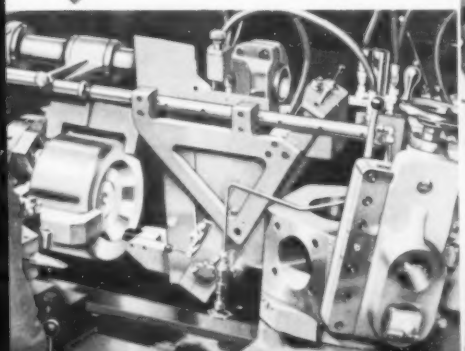
Operation 2



Workpiece and tooling for first finishing operation on 10½″-diameter, 5¼″-wide bowl shell. Note JETracer slide tools mounted on opposing faces of the hexagon turret.

Close-up of workpiece and turret-mounted JETracer slide tool for second finishing operation. Note how overhead sliding template carrier locates for length from adjustable bracket on overhead pilot bar.





WANT TO SIMPLIFY FIXTURE WORK AND SAVE MONEY?

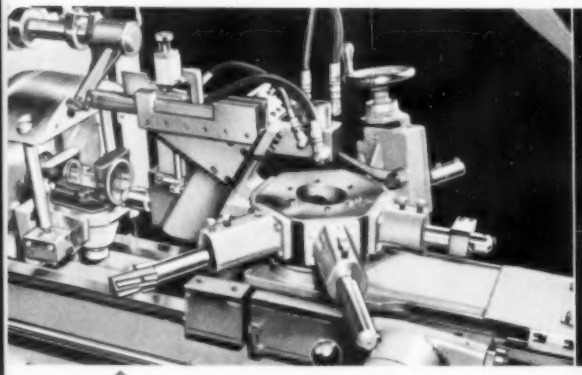
JETracer slide tool cuts tooling costs for ram type turret lathe work

If you have to machine parts held in fixtures or handle multiple-diameter boring operations, tuck this page in your files for reference. It shows how tracing can cut your costs, save time and simplify machining of parts like this chrome-nickel-steel truck steering knuckle forging.

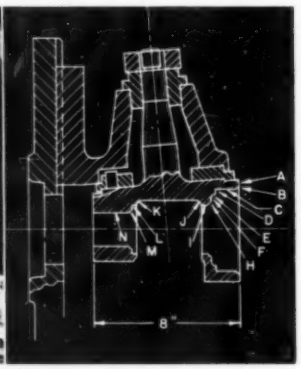
The spindle end, previously machined, is located from a circular slot on the spindle O.D. The part is hand-clamped in a counterbalanced angle plate fixture on a standard MASTER-LINE No. 5 Ram Type Turret Lathe. Although the part and fixture require a swing clearance of 21¾", the standard No. 5 handles it without modifications. A saddle extension is used to minimize tool overhang and provide maximum rigidity when finishing to close-tolerance bores.

The turret-mounted JETracer slide tool on hex 1 simplifies machining and eliminates the additional tooling normally required to machine the eight separate surfaces at the front of the part. Length setting is speeded by a feed dial, an integral part of the standard longitudinal feed handwheel assembly. As the turret ram feeds forward, the tracer stylus and the tool-carrying slide follow the template contour, generating surfaces A-B-C-D-E-F-H-I in one pass. A multi-diameter cutter on hex 2 machines L-M-N. N is finish-bored from hex 3 and diameters C-I are finished from hex 4. A rapid slide tool on hex 5 bores and forms J-K to complete the part. Tolerances on the 8"-long part are held within .0014" on bore C, within .001" on bore N and within .005" on bore I. F.t.f. time is only five minutes.

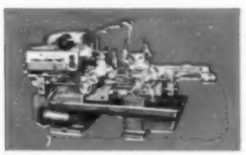
Turret-mounted JETracer slide tool saves time, eliminates need for usual cross-slide carriage and extra turret tooling, reducing original equipment cost. Entire JETracer assembly indexes with the turret and does not restrict use of other tooling.



Workpiece and tooling showing how tracer template and carrier bar obtain length location from adjustable bracket attached to overhead pilot bar. Note absence of standard cross-slide carriage and consider savings in original equipment and tooling made possible by JETracer.



Workpiece showing surfaces machined with this setup. Turret-mounted JETracer slide tool handles eight surfaces on right end of part in one pass, saving time and simplifying operator's job.



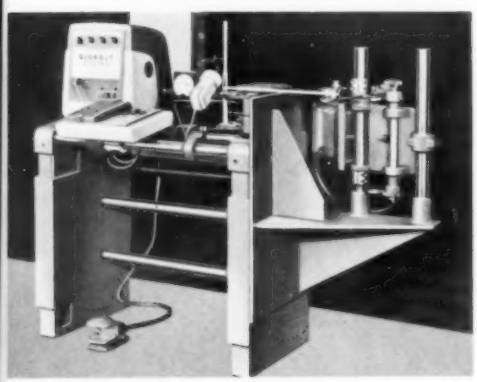
HOW SACO-LOWELL SHOPS INSPECT HIGH-SPEED TEXTILE PARTS

Balancing before assembly saves time, cuts losses

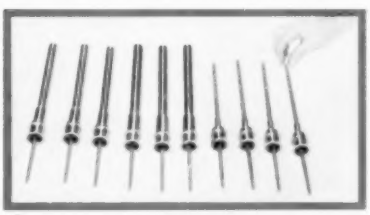
Vibration can be costly in the textile industry where speeds of 11,000 r.p.m. are not uncommon. At these high speeds, even small amounts of unbalance exert great force on supporting bearings and cause high-frequency vibrations that can lead to excessive maintenance and spoiled work. Here at the Saco-Lowell Shops, Biddeford, Maine, a Gisholt 1SM Balancer is used to check product quality *before assembly* to eliminate costly time and production losses caused by vibration in high-speed spinning operations.

Typical parts shown below include whorl-and-tube and blade-and-whorl assemblies used to support and drive the tubes or bobbins of yarn used in manufacturing textiles. The long, lightweight spindle operates at from 8,500 to 11,000 r.p.m.

To simulate actual operating conditions, the balancer is set up to rotate parts in vertical position. Standard, horizontally mounted driving motor and vibration pickups are tipped 90° and mounted at the right end of the machine. A bolster insert, which is an actual part of the spindle, provides bearing surfaces to support the spindle blades and is held at the base end in a special vibratory fixture. The spindles are belt-driven from the crown pulley on the whorl as in actual production. The driving motor is easily adjusted, up or down, to align the pulley with the part when changing over to different sizes. Because electrical means are used to locate and measure unbalance, there is no restriction on the method used to support or drive the parts. Full machine accuracy permits measuring bearing movements as small as .000025" in either one or two preselected correction planes. The average workpiece is inspected for unbalance in less than one minute.



Driving motor and vibration pickups are mounted at right end of balancer to permit balancing of high-speed textile machinery parts in vertical position.



Typical parts checked for unbalance with this setup. Hand gives size comparison. Operating speeds of 8500 to 11,000 r.p.m. make inspection by balancer imperative for smooth, trouble-free operation.

This simple, effective means of checking parts and assemblies before they are placed in operation eliminates costly time and production losses through broken yarn or rapid wear caused by excessive vibration of high-speed parts.

HOW TWIN DISC SIMPLIFIES CONTOUR MACHINING

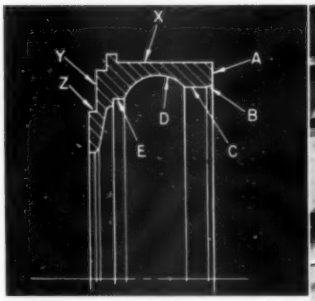
JETracer provides finer finish; auxiliary slide handles extra surfaces

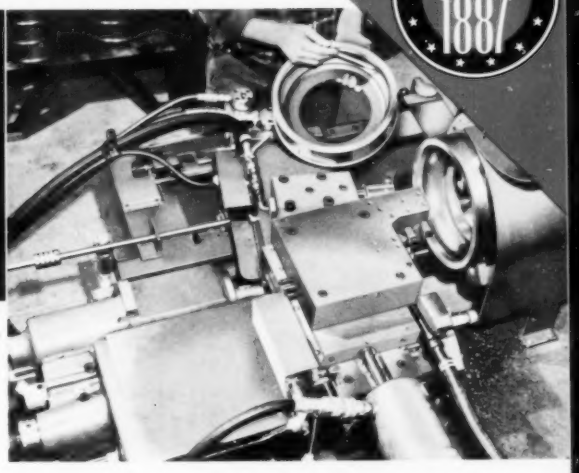
MASTERLINE GISHOLT SINCE 1887

Here's a way to avoid the high cost of form tools as well as the cost of regrinding and lost machine time while tools are changed and reset to size. It's the way the Twin Disc Clutch Company's Hydraulic Division plant at Racine, Wisconsin, uses a standard MASTERLINE No. 12 Automatic Production Lathe with modern JETracer to generate a large radius in cast iron rotating housings for hydraulic torque converters.

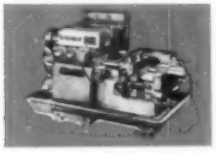
Special equipment includes a front-carriage JETracer slide and a single-pass template carrier, adjustable longitudinally and for taper. A variable-feed pump is used for the front carriage to provide a uniform feed rate to the single-point tracing tool, especially important for a fine surface finish as the tool generates the steep contour in the bore.

Here's the operation on a typical 12⅜"-diameter, 3⅜"-wide part. Surfaces X-Y-Z are previously machined. The work is centralized on diameter Z with a chuck-mounted pilot ring, located against face Y and chucked at X in a 15", 3-jaw, compensating-type air chuck. The front JETracer slide rough-bores C and generates the 31/32"-radius D. At the same time, the rear independent slide finish-bores C-E and chamfers B, using standard longitudinal feed movement. Then an auxiliary slide, mounted on the rear slide, rough- and finish-faces E to complete the part. F.t.f. time is only 3.12 minutes.





Operator indicates 31/32"-radius, 1⅝"-long-groove D. Note massive tool block, mounted on auxiliary slide to permit machining extra surfaces using standard longitudinal feed of rear independent slide and transverse feed movement of the auxiliary slide.



Three different part sizes are handled with the same basic setup. Change-over requires new sets of chuck jaws, a different pilot ring, rear tool block and tracer template, and adjustment of stops.

JETracer speeds and simplifies radius or contour machining, improves product quality. Variable feed provides fine finish in 31/32"-radius, 1⅝"-long-groove D. Rigid setup holds parallelism between faces and size of bore C within .003" tolerance.

SAME MACHINE SUPERFINISHES INNER AND OUTER TAPERS

Two-machine setup corrects part geometry, eliminates rejects, saves time

Here's how a big automobile manufacturer uses this high-production Superfinishing setup to correct part geometry and save time on difficult inner and outer tapered surfaces.

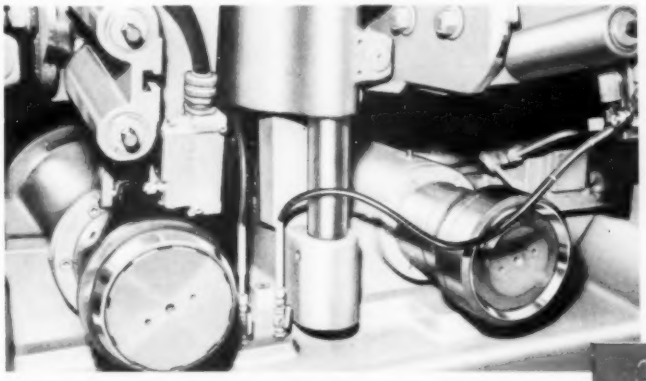
The workpieces are steel transmission cones which come to the Superfinisher turned, bored and heat-treated to 48-52 Rockwell "C", with a surface-finish of 80-100 micro-inches RMS. The operation is handled on two Model 54 High-Production, Two-Spindle Cylindrical Superfinishers. The Model 54 is ideal for this work since it is designed to handle parts of small or medium size, with two independent work stations.

Because previous operations cause some distortion and leave extra heavy walls on some pieces, one Model 54 is used to rough the O.D. and I.D. surfaces, correcting part geometry and cleaning up surface defects. The second machine produces the low micro-inch finish required for smooth operation and long service life.

The tapered outside diameter is handled on the left work station. The part is held in a fixture, centralizing and locating in the bore and clamping back on the lugs in the bore. The tapered inside diameter is handled on the right work station. The part is held in a collet-type fixture, centralizing and locating on the tapered O.D., clamping back against the lugs.

The roughing operation takes 40 seconds f.t.f. time at each station. The finishing operation is completed in only 30 seconds f.t.f. at each station. The final finish on both O.D. and I.D. surfaces is 3-4 micro-inches RMS.

Two-machine setup saves time, improves product quality. Using one Superfinisher to rough and another to finish virtually eliminates rejects because part geometry is corrected by roughing operation. Work flow is fast, from left to right, with one operator on each machine.



Close-up of tooling setup on two-spindle Model 54 Superfinisher. Tapered O.D. is handled on left station; tapered I.D. is handled by offset stone-holder on right station. General machine view shows control panels for individual stations that permit handling different operations on same machine.

GISHOLT

MASTERLINE
GISHOLT SINCE 1887

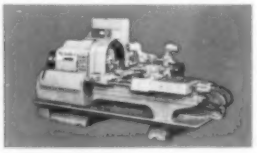
SETUP SAVES CUMMINS ENGINE COMPANY, INC., 1.5 MIN. PER PART

Combined operations cut time 35%, improve accuracy and finish

You'll want to remember this smart tooling setup at the Cummins Engine Company, Inc., Columbus, Indiana, plant. It shows how combined cuts are used to improve concentricity, parallelism and surface finish on die-cast aluminum diffuser plates for Cummins "Turbodiesel" Engines.

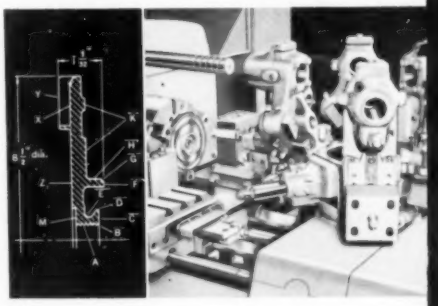
The machine is a MASTERLINE 1F Fastermatic Automatic Turret Lathe. Special accessories include a 2-speed motor, automatic forward and reverse spindle controls, a turret-facing attachment and a special turret-facing slide tool.

The parts are located against face X and held at W in a 12″, 3-jaw air chuck. Drive is against vane Y. Spring-loaded, manually locked pins provide extra support near center at Z.

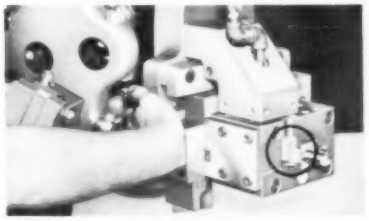


Here's the automatic machining cycle: Hex 1—drill A, rough-turn D-E-H, chamfer G while K is rough-faced from front cross slide; hex 2—semi-finish-turn H, bore A, chamfer B while rear cross-slide tools finish-face K, rough-face F; hex 3—turret saddle traverses forward and holds as turret-facing attachment on rear cross slide provides transverse movement to turret-facing slide tool, facing F-C and back-facing M at the same time. A cam-operated auxiliary slide, inside the turret-facing slide, follows an angular path, entering the limited space between face F and diameter D to undercut E. Reverse feed is used to clean up the surfaces and clear the tools for withdrawal. Hex 4—finish-turn H; spindle reverses and low-speed side of motor is used while a left-hand, 10 TPI thread is tapped in bore A from hex 5. When tap bottoms, turret dwells and spindle reverses to withdraw tap. Spindle speed is increased as A is bored from hex 6, removing the crest from the threads to create an oil-slinger groove. Groove depth is held to ±.006″ to govern flow of oil to the turbocharger. Time, f.t.f., is only 2.7 minutes.

Flexible automatic cycle and minimum special tooling permit machining of undercut, tapping and simultaneous facing of front and back surfaces; save extra operation and assure parellelism between faces.



Workpiece and tooling for die-cast aluminum diffuser plates. Rigid setup with overhead-piloted multiple tool holders simplifies holding close tolerances. Workpiece drawing at left shows surfaces machined.



Close-up of special turret-facing slide tool. Note cam-operated auxiliary slide, encircled, used to undercut E.

JETracer SAVES 71.5 MINUTES ON THIN-WALL PART

Four-pass JETracer slide saves time, improves accuracy and finish

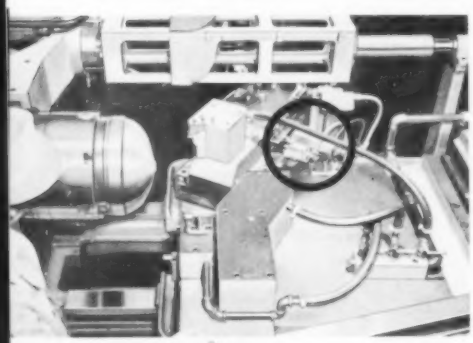
If you're having trouble machining thin-wall parts with difficult contour, facing or forming cuts, this setup at a well-known manufacturer's plant will give you fresh ideas.

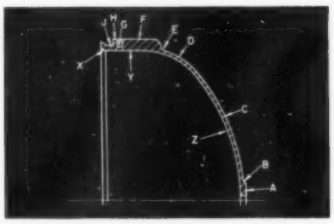
The workpieces are tough 4031 steel pressure bulkheads. A standard MASTERLINE Simplimatic Automatic Lathe is used. Special equipment includes a JETracer-controlled rear independent slide with a 4-pass indexing template carrier and variable-speed motor to provide a constant surface-cutting speed.

The 14″-diameter, 6⅜″-wide parts are located on face X, against a locating ring with jacks supporting at Z, and chucked at Y on a 15″, 3-jaw, air-operated chuck. Pie-shaped jaws centralize and minimize distortion.

Here's the automatic machining cycle: The platen table feeds to bottom and holds as dome face A is machined from the front slide. The table retracts and then feeds in while O.D. surfaces B-C-D-E are traced. A variable-spindle-speed control provides a uniform surface-cutting speed on all diameters. Then, the table and JETracer slide retract; the template carrier indexes, and the same surfaces are traced again. Four passes are required to finish O.D. contour. After the last JETracer pass, the front slide forms locking groove surfaces F-G-H-J. Final wall thickness is .073″. Surface finish is 40-50 micro-inches RMS. Time f.t.f., 18.5 minutes.

Multiple-pass JETracer slide permits one to three roughing cuts and final finish cut. Relatively inexpensive accessories and standard Simplimatic save extra operations and cut 71.5 minutes from previous time on this job.





Compact tooling arrangement simplifies machining of problem part. Note 4-pass indexing template carrier above independent JETracer slide. Rheostat, encircled, at right of JETracer slide varies spindle speed during tracing.

No. 7-858
710

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

Printed in U.S.A.

GISHOLT MACHINE COMPANY Madison 10, Wisconsin

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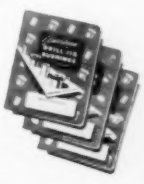

Why you should know more about this new line of air tools

Now, more than ever before, you have to be cost-conscious. That's why Gardner-Denver has made the new No. 1 air tool motor—made it more powerful, yet more efficient.

Now, more than ever before, time saved is money in the pocket. With its greater speed-torque range, the new No. 1 air tool line does hundreds of light-fastening jobs faster.

Noise reduction is always welcome. Gardner-Denver's muffled exhaust quiets motor whine . . . relieves fatigue.

2 NEW DRIVERS

12E-1 Keller In-Line Screw Drivers
- Sets machine screw sizes from 0 to 6
- Write for Bulletin 12E-1

12G-1 Keller Angle Screw Drivers
- Sets sizes 6 and 8 machine screws
- Write for Bulletin 12G-1

2 NEW SETTERS

16E-1 Keller In-Line Nut Setters
- Sets machine nut sizes from 0 to 6
- Write for Bulletin 16E-1

16G-1 Keller Angle Nut Setters
- Sets sizes 8 and 10 machine nuts
- Write for Bulletin 16G-1

2 NEW DRILLS

11A-1 Keller Straight Drills
- Drills holes to $\frac{5}{32}$"
- Write for Bulletin 11A-1

11G-1 Keller Angle Drills
- Drills holes to $\frac{5}{32}$"
- Write for Bulletin 11G-1

Like all air tools in Gardner-Denver's Keller line, the new No. 1 tool line is available with dozens of interchangeable attachments for many fastening jobs.

Write for the bulletins mentioned above for complete information on the tools of your choice. Or call in your Gardner-Denver air tool specialist.

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Gardner-Denver Company, Quincy, Illinois
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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-7-22

New rigidity, economy and exact adjustment

The New Staples Expansion Machine Reamer*

This new Carbide Reamer combines the rigidity of a solid body reamer with exact, parallel size adjustment to compensate for wear. The shell-type construction allows easy, economical replacement.

They are made in a wide range of sizes and styles to fit your requirements. Write today for further information.

*Patented

58-1

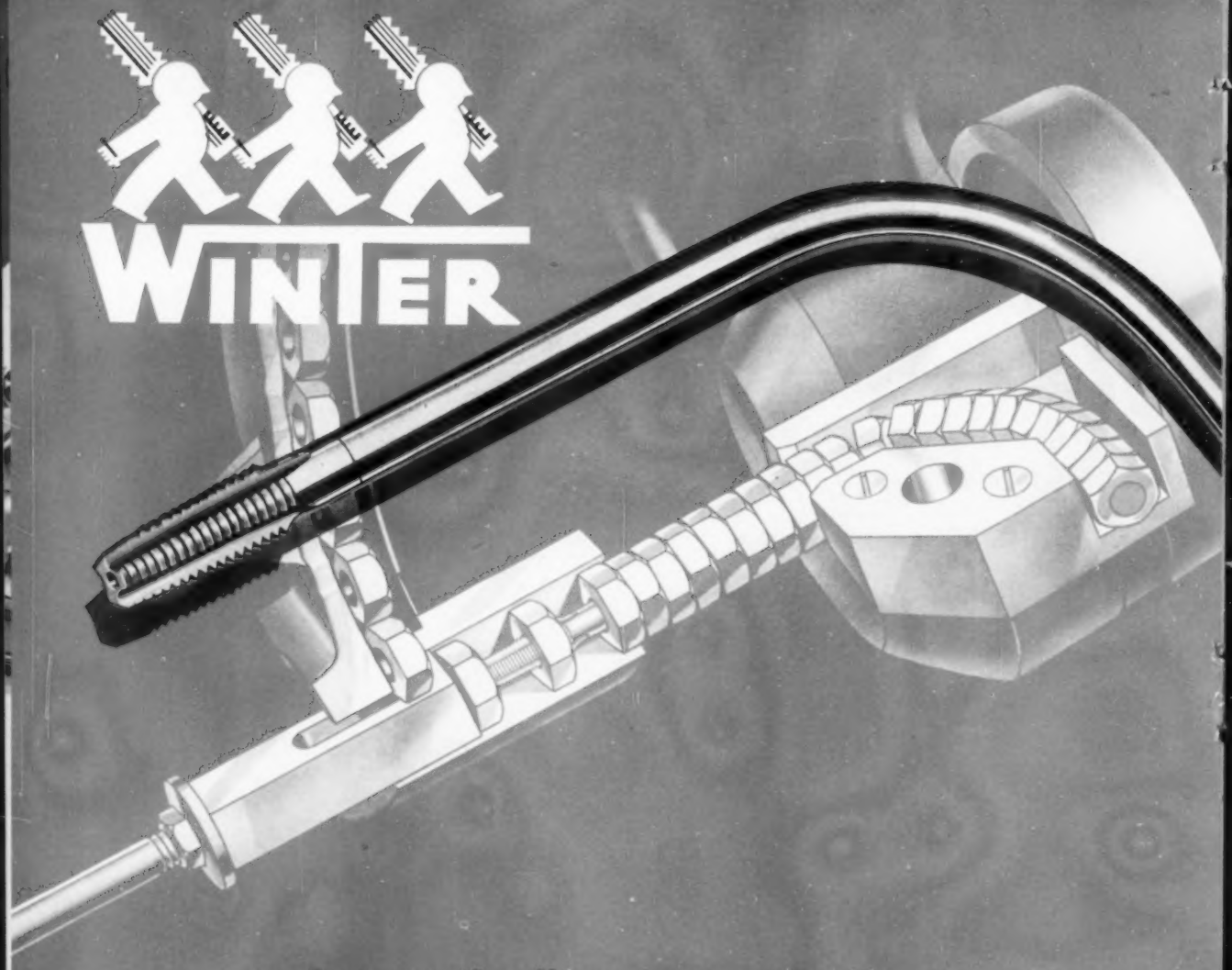
Staples

ROTATING CARBIDE TOOLS

THE Staples TOOL COMPANY

2352 Glendale-Milford Road, Cincinnati 15, Ohio

WINTER



Automatically—you get better threads with BALANCED ACTION Taps

Fast, accurate nut tapping—automatically? It's easy with Winter Balanced Action Taps, skillfully crafted from the finest high-speed steel for dependability and long life.

Winter has developed its own machines to produce taps with uniform fluting, precision chip-driver contours and concentric chamfers for optimum performance.

Every Winter Tap has Balanced Action—a guarantee of consistent quality and faultless performance. Make Winter Balanced Action Taps your first choice, too.

WINTER BROTHERS COMPANY
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Distributors in principal cities. Branches in New York • Detroit • Chicago • Dallas
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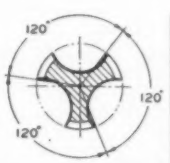
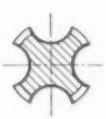
CALL YOUR DISTRIBUTOR for standard and special WINTER Balanced Action Taps, Dies, and Gages.

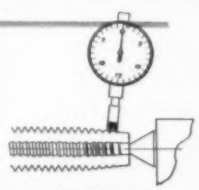


EXACT FLUTE SPACING



UNIFORM FLUTE CONTOURS

PRECISION CHIP DRIVER CONTOURS



ACCURATE AND CONCENTRIC CHAMFERS

CARBIDES— "Research Improved" for today's tougher metal cutting jobs

Perfection in Carbide Tools, as in the complete line of high-quality National tools, is born of a never-ending search for the best metal cutting methods and tool design, "Research Improved" carbide-tipped counterbore cutters, for example, are proof of the way National turns its progress into your profit.

By meeting the challenge of today's tougher metals through continued research, National makes available now the tools for tomorrow's products.

NATIONAL TWIST DRILL AND TOOL COMPANY

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CALL YOUR DISTRIBUTOR for NATIONAL twist drills, reamers, counterbores, milling cutters, end mills, hobs, carbide and special tools.

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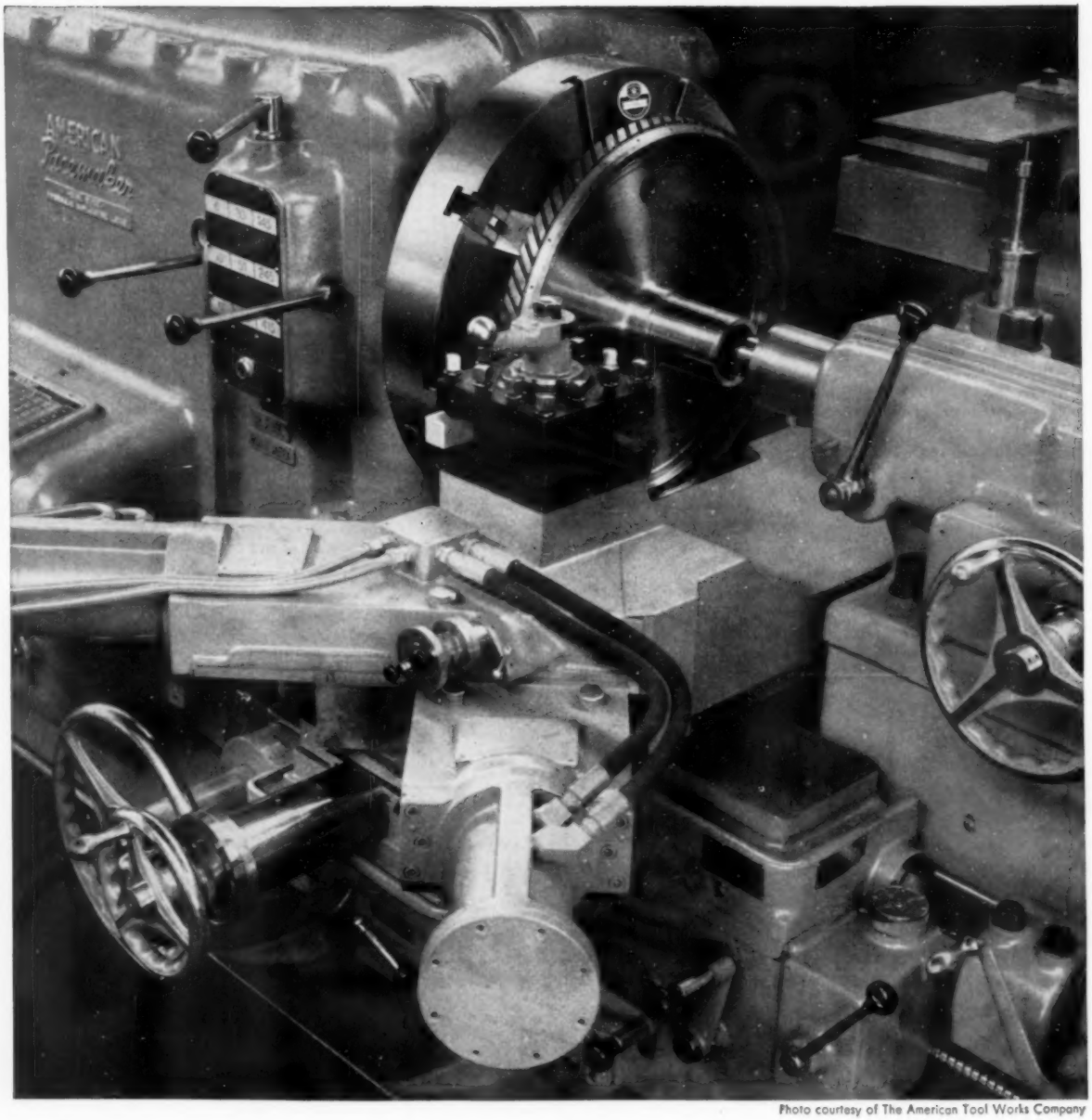

Photo courtesy of The American Tool Works Company

THE LATHE — *American Pacemaker 25" Style "G" Hydraulic Duplicating Lathe*

THE OPERATION — *Machining a jet engine compressor wheel*

THE CHUCK — *Horton, of course*

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What every designer should know about

FACE GEARS for Angular Drives

FACE GEARS have distinct advantages which the designer should know. They can be spur or helical, "on-center" or "off-center." The mating members are pinions. Both are generated on Fellows Gear Shapers by cutters having involute teeth.

Utilization of face gears results in a simple, compact design that can be economically manufactured and assembled.

Consider all these advantages:

- quality cutting at low cost
- easier and lower cost assembly
- no appreciable thrust
- pairing for reversal of direction
- tooth bearing not affected by axial displacement of pinion

GET ALL THE FACTS:

Information on the design and cutting of Face Gears is free for the asking. Just write to:

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont

Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE PRECISION LINE **Fellows** *Gear Production Equipment*

be a Profit prophet ...without Crystal Ball!

Users of U. S. Adjustable Drill Heads are unusually accurate in anticipating profit pictures— they regularly figure lower and *more dependable costs.* That's because these high-quality heads—priced right to start with—usually cost less to maintain, less to operate.

The U-1 Head shown has 8 drivers, ¼" drilling capacity in cast iron, 6" diameter drilling area. With 2 spindles and Erickson chucks, it costs only $260.

And that's because ALL U. S. Heads of this type have these plus features:

SHAVED GEARS for smooth, quiet operation.
SPECIAL UNIVERSALS with heat treated joints, neoprene sealed and lubricated for life.
ALUMINUM BODY CASTING with special 33,000 lb. tensile.
GREATER BEARING AREA for the spindles.
QUICK CHANGEOVER for different hole patterns.
SLIP SPINDLE PLATE, providing the advantage of a fixed center head on long runs.

Write for catalog AD-57. Immediate delivery on most standard sizes.

Adjustable and Fixed Center Multiple Drilling Heads
Individual Lead Screw Multiple Tapping Heads

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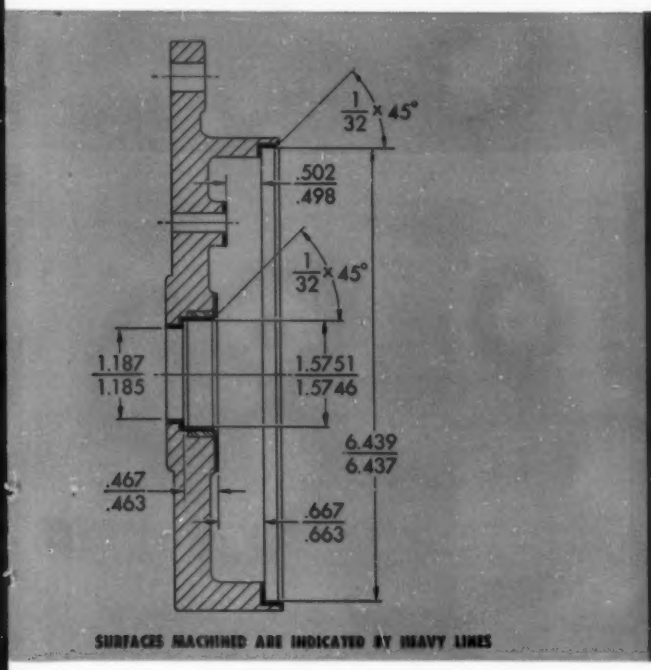
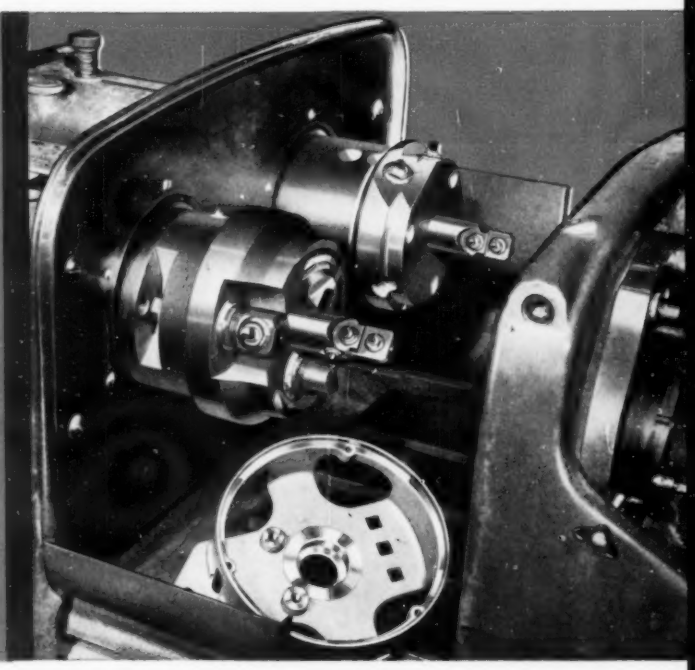
UNITED STATES DRILL HEAD CO.

BURNS STREET • CINCINNATI 4, OHIO

9 surfaces rough and finish machined in 2 passes...





HOW MICROBORE CLUSTER TOOLING DOES IT ON A PRECISION BORING MACHINE!

Special Microbore Cluster Tooling makes it possible for a leading electrical equipment manufacturer to obtain a continuous flow of finished parts by rough and finish machining, simultaneously, nine surfaces on a generator end bell casting in two passes.

SET-UP TIME IS FASTER, TOO—Independent, precision adjustment of each tool point permits accurate settings in a matter of seconds. Speed and accuracy of adjustment, plus compactness of Microbore units, makes cluster tooling practical to a degree formerly considered impossible.

Microbore is a versatile tool with unlimited application for all types of boring, turning and facing operations. Microbore Standard Boring Bars, Boring Bar Sets and Flash-Change tooling complete the perfect combination for accurate, quick change tooling.

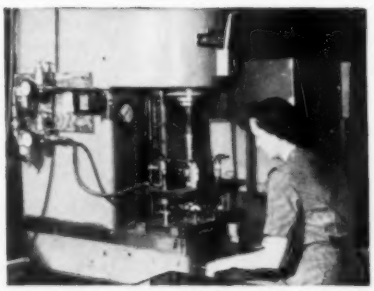
To find out how Microbore can help you, write for our new catalog No. 58.

DeVlieg Microbore System

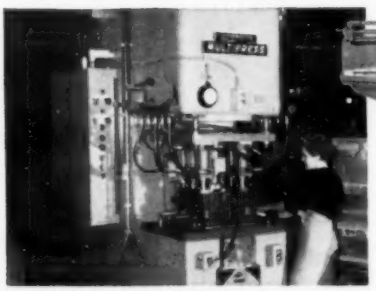
DE VLIEG MICROBORE • DIVISION OF DE VLIEG MACHINE COMPANY

2720 West Fourteen Mile Rd., Royal Oak, Michigan

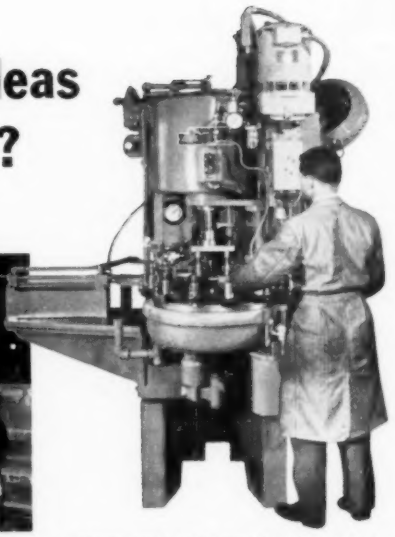
Which of these MULTIPRESS ideas will save you money...NOW?



Toy maker forms 1000 parts per hour . . . 8-ton Multipress forms metal toys faster, at less cost for Mattel, Inc.



Motorola speeds production... with 100-ton Multipress that precision-punches up to 450 holes at a time in plastic TV chassis bases.

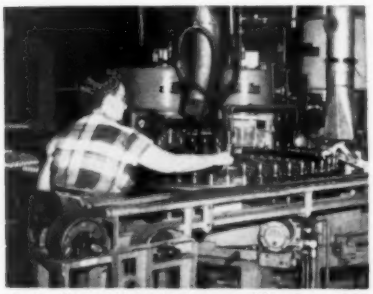


Dormeyer triples production of food mixer parts . . cuts scrap loss, too, with 8-ton Denison Multipress—12-station index table.

Waterman boosts output 800% with 1-ton Multipress that "angles" precision C/C pen parts fast, at low cost.

Cuts cost 73% on sub-assembly of specialty products at George S. Thompson Corp with 4-ton Multipress. Savings—11¢ per unit.

Prints Electronic circuits 3 times as fast at Barry Process Co. with 4-ton Multipress. Controlled timing and pressure assure uniform carbon ink deposit on each printed resistor.



Auto-lite automates assembly of over 150 different types of spark plugs with a battery of 3 Multipresses operating around a 48-station index table.

Production up 33% at Cleveland Graphite Bronze—where 25-ton Multipress compresses soft carbon cores at the rate of 100 per hour.

Trimming rubber flash twice as fast... 4-ton Multipress with 6-station index table trims flash from 2400 molded rubber parts per hour. Old method called for 3 operations.

Time and money savings like these are only a few of hundreds that Denison Multipress can help you make in keeping ahead of competition today.

But modern competition means more than simply faster production. That's why *Multipress plus-benefits* are so *important.*

Multipress on your job can mean larger tool and die life . . . less scrap . . . higher product quality . . . minimum maintenance . . . extra operator safety. *Multipress can give you the competitive edge.*

Isn't it time *you* looked into Multipress? Your Denison Hydraulic Specialist can show you where and how Multipress will pay off best on your next job.

TOOLING AND PRODUCTION MEN! WRITE FOR YOUR COPY of the new DENISON MULTIPRESS all-line catalog 120-D. Specifications and application data for all-industry uses. Multipress 1 to 75-ton capacities.

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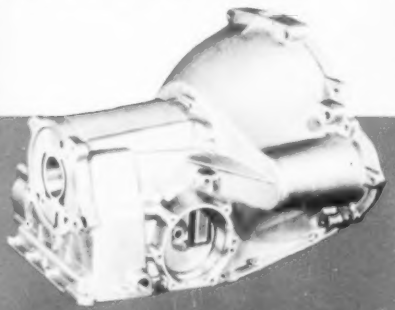
EX-CELL-O Precision Production News

COST-CUTTING IDEAS FROM EX-CELL-O CORPORATION — DEVOTED TO MINIMIZING COST OF PRODUCTION

Over-all view of 24-station, 75-foot long transfer machine looking from loading end. A typical high production automation machine by Ex-Cell-O.

58-31A



Aluminum automobile transmission case after automatic precision boring, tapping, precision fly cut milling, gaging and flushing on Ex-Cell-O Transfer Machine.

120 parts per hour —automatically!

24-station transfer machine performs multiple machining of automotive transmission housings in high-speed, automated production . . .

At the touch of a button, this Ex-Cell-O Transfer Machine turns aluminum castings into finish-machined automatic transmission housings at a rate of *one every 30 seconds.*

From its first-station loading, through complex machining operations, to its unloading section 24 stations later, this 75-foot-long unit produces labor savings, time savings and precision parts —automatically.

Machining steps include semifinish-and-finish facing, precision boring at five different stations, tapping and precision fly cut milling. Air gages monitor all boring operations and parts are oriented automatically—turned 90° for boring at one station, inverted 180° at another for milling on four surfaces.

Ex-Cell-O Transfer Machines may be the high-production answer to your manufacturing problems. See your Ex-Cell-O Representative, or write direct for further information.

3 MORE COST-CUTTING IDEAS

The precise answer to higher production

When product demand goes up, versatile Ex-Cell-O Duplex Machines answer the problem of supply

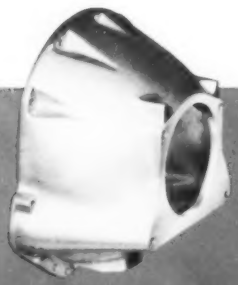
A large auto manufacturer recently increased production of torque converter housings *automatically* by using three Ex-Cell-O Style 432 Duplex Vertical Boring Machines.

Two double-station machines finish-face the engine-mounting end of the cast-aluminum housings, and semi-finish the opposite face. The third machine is tooled to finish-face the transmission-mounting end and to bore and chamfer a 7.003"-7.006" hole.

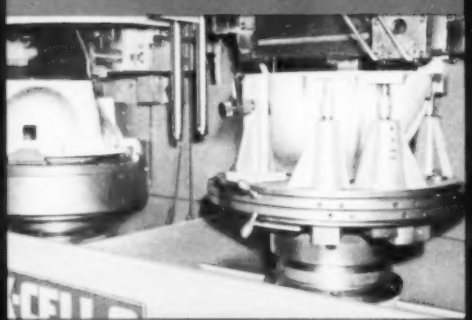
Ex-Cell-O Duplex Machines also perform such operations as precision turning and grooving; stations can be operated independently for different parts and operations, or set up for identical operations.

Find out how Duplex versatility can increase precision production in your plant: Call your local Ex-Cell-O Representative today, or write direct.

58-318

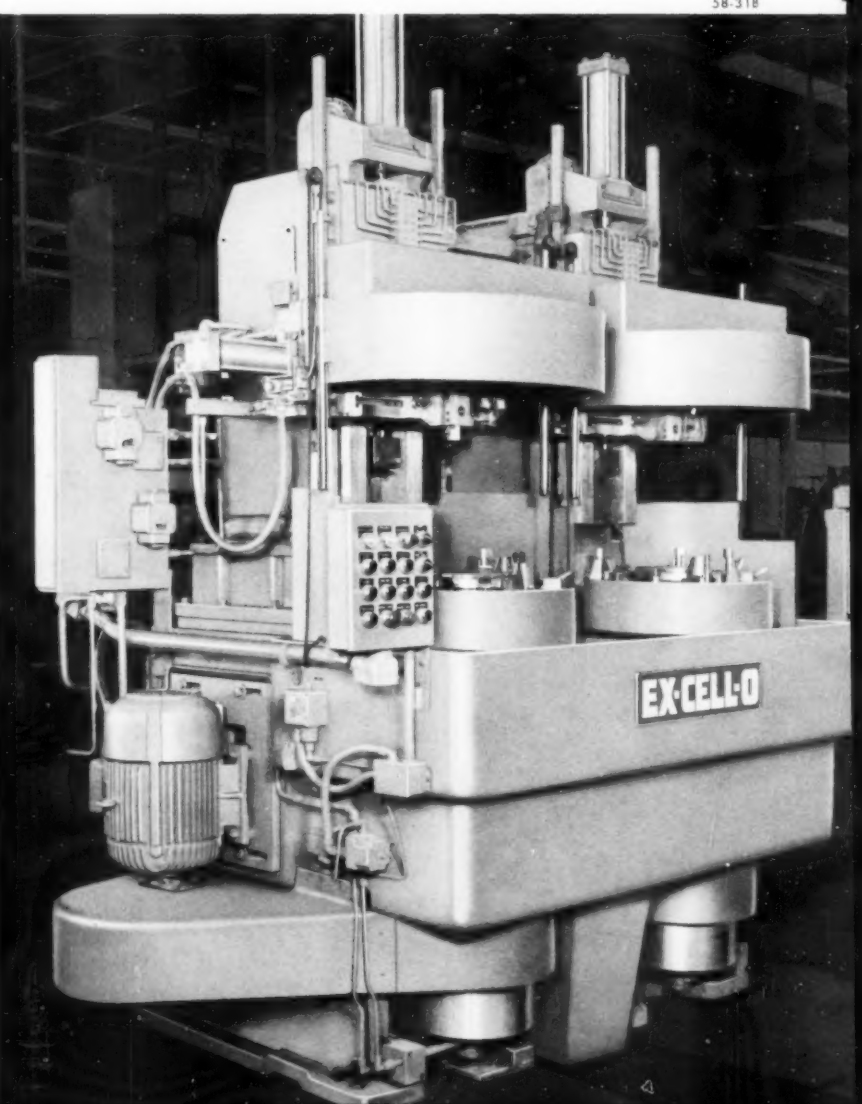


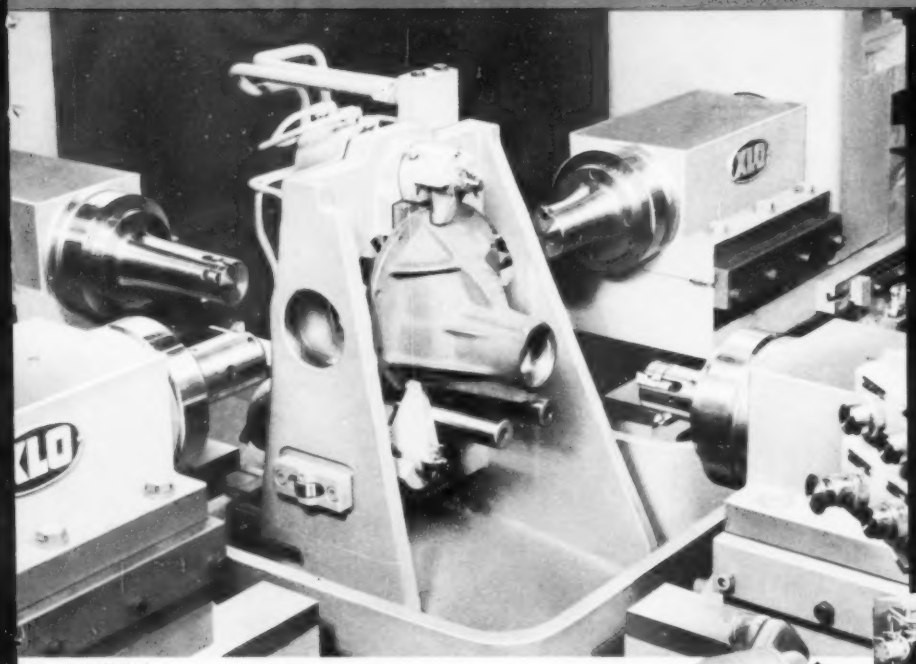
Aluminum torque converter housing, shown after machining, is completely roughed and finished at both ends and chamfered and bored by three Style 432 Duplex Vertical Machines.



Above: **At station 1 (left) part is semi-finish-faced on the transmission end by one tool; at station 2, the engine-mounting end of the part is finish-faced by two tools making a single pass.**

Right: **Duplex Vertical Boring Machine is used for high-volume production of automatic transmission housings. Style 432 performs various machining operations alone or in any combination.**



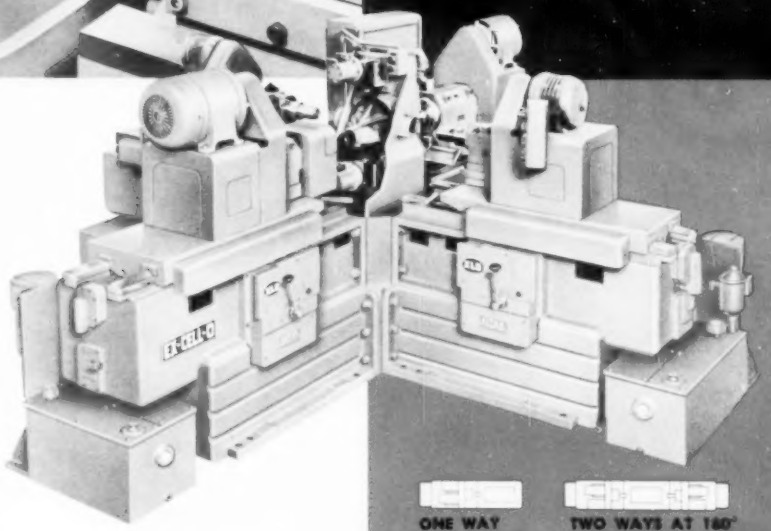


Close-up of 4-way machine shows Ex-Cell-O Precision Spindles used to assure accurate boring of pinion bearings and cross-holes in an automotive differential housing.

Below: Working simultaneously from four directions, this Ex-Cell-O Way-type Machine is made up of four standard units joined with a standard center section for precision location of the workpiece and precise 90° relationship between spindles.

58-31C

Operations Combined to Boost Profits

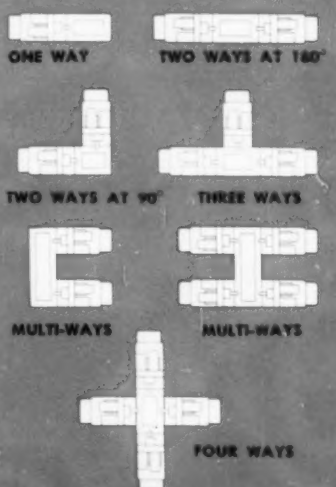


4-Way Precision Boring Machine works simultaneously from 4 directions for fast, accurate production

The differential carrier assembly above is typical of parts machined quickly, easily and economically on Ex-Cell-O Way-type Machines. On this particular job, bore relationship is maintained at a true 90° and bore diameters are held as close as .0005".

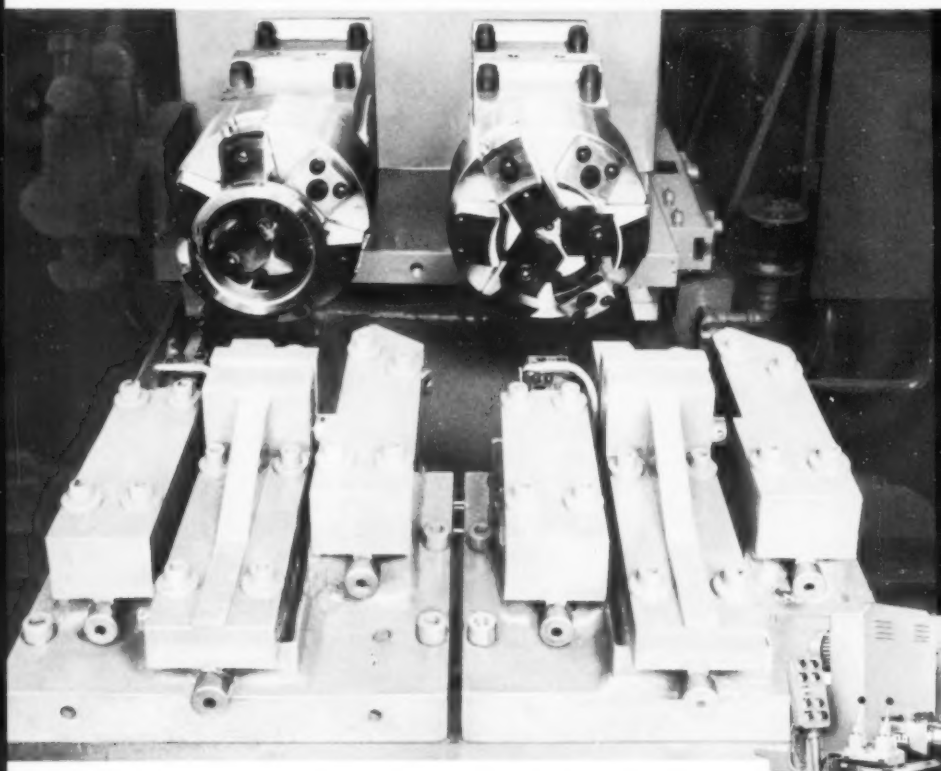
Ex-Cell-O Way-type Machines consist of standard units combined into a single machine with a standard center section for precise, simplified parts location. They can be used singly or utilized in fully automated lines.

If your production plans—present or future—demand utmost accuracy with high output, look into the many advantages of Ex-Cell-O Way Machines by calling your local Ex-Cell-O Representative today or, if you prefer, by writing direct.

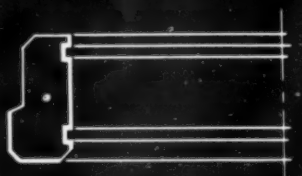


Standard Ex-Cell-O Way units can be combined in these combinations for precision boring, turning, facing, grooving and chamfering.

EX-CELL-O PRECISION PRODUCTION NEWS



Left: In this Style 312 three individually adjustable tool blocks at each station hold grooving tools, boring tool and a tool for facing, chamfering and turning operations.



Above: Machining steps are shown by heavy lines on cross-section drawing. *Below:* This Style 312 is also suited to the intricate contour-machining required in aircraft and missile development.

More Operations—

FASTER!

Cam Boring Machine precision faces, chamfers, turns, bores and grooves 140 steel transmission races per hour

A two-spindle Style 312 Cam Boring Machine is combining precision with high volume production of steel transmission races made by a major automobile manufacturer.

Air-operated chucks hold the parts in the spindles. Two sets of tools—four tools in each set—are mounted on the cross-slide. The first tool faces, chamfers and turns; the second bores the I.D., holding to plus-or-minus .001″ tolerance. Tools three and four plunge the two grooves, radiused to .010″. Critical dimensions are held to close limits on all machining cycles.

The precision-built Style 312 is particularly suited to the intricate contouring required by aircraft and missile components.

Your Ex-Cell-O Representative can provide full details, or write directly to Ex-Cell-O.

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

XLO
EX-CELL-O FOR PRECISION

MANUFACTURERS OF PRECISION MACHINE TOOLS
GRINDING AND BORING SPINDLES • CUTTING TOOLS
TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS
DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

Tests show GRAPH-MO® tool steel

WEARS LONGER

If you want a tool steel that wears longer, try Graph-Mo®. Reports from users themselves show that Graph-Mo averages three times more wear than ordinary tool steels. The reason is the combination of free graphite and diamond-hard carbides in the Graph-Mo structure.

MACHINES FASTER

If you want a tool steel that machines faster, use Graph-Mo. Graph-Mo out-performs ordinary tool steels on the Constant Pressure Machinability tests. The free graphite in the Graph-Mo structure enables you to make gages, dies and other tool steel parts faster.

REDUCES GALLING

If you want a tool steel that reduces galling, buy Graph-Mo. Tests on the Amsler Wear Machine show Graph-Mo steel has twice the resistance to galling compared with ordinary tool steels. There's far less tendency to pick up and scuff. And you can't buy a more *stable* tool steel anywhere. Get all these big advantages. Specify Graph-Mo for all your tool steel parts. You'll save time and money, have a better finished product. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

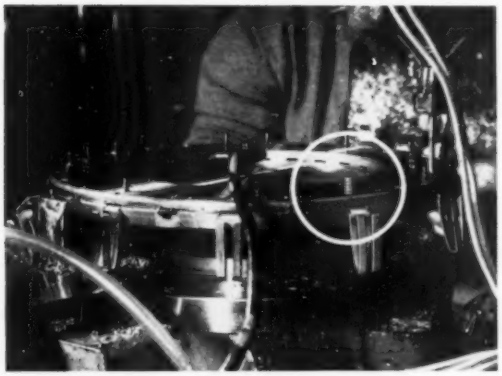
TRADE-MARK REG. U. S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

Practical Tooling Tips

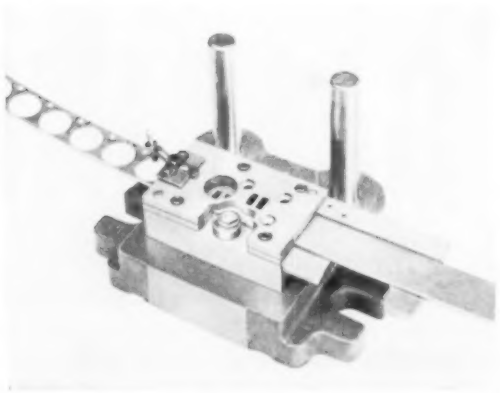
No. 3 of a series

Are your tool makers wasting time making complicated tooling gadgets when a standard, off-the-shelf Vlier part could do the job much better? Why not examine your present drawings and see where these simple, low-cost parts can be used. You will be amazed at the savings possible.



PRODUCTION INCREASED 300% when this 12-station automatic indexing and tapping fixture was put to work. Vlier Spring Plungers allow the operator to load by simply pushing the part into a slot. These simple, spring-loaded tools also position the part for the tapping operation. Available in four models; fifty sizes.

NEW SWIVEL PAD-TORQUE THUMB SCREW combines the Vlier Torque Thumb Screw and Swivel Pad Clamp. The result is a perfect holding tool—one that applies only the right amount of holding pressure without damaging the finished surface. Unique ball joint construction of the pad permits adjustment to off-angle surfaces.



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NEW 1958 CATALOG NOW AVAILABLE—Eight pages; completely revised. Includes information and specifications on all new Vlier products, including the Torque Handle, Stock Pusher, Leveling Pad. Makes ordering easy. Suggests new uses for these proven time-savers. Write for your copy today!

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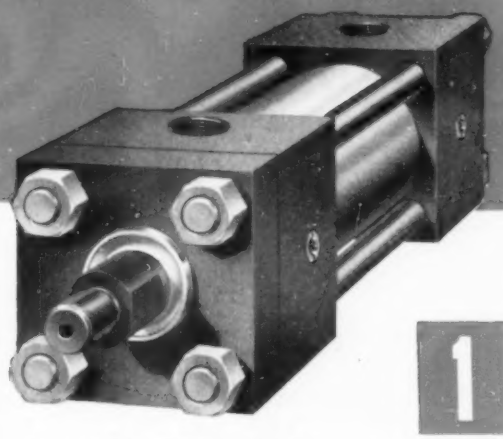
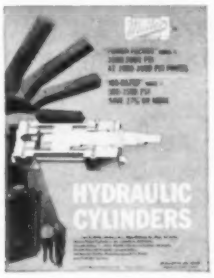
Petroleum base, fire-resistant and special hydraulic fluids cause distortion and rapid deterioration of the seals currently used in many hydraulic cylinders, resulting in costly repairs and cylinder failure. (Seals made of synthetic rubber are not compatible with even 50% of available commercial petroleum base fluids and the life of such seals is materially reduced at operating temperatures above 150° F.)

Specify Miller HYDRAULIC CYLINDERS

FOR UNLIMITED SEAL LIFE!



Request Bulletin JH-104N for complete data plus helpful charts on column strength, cylinder forces, factors of safety, acceleration, pipe pressure losses, etc.



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No blind assembly. Is
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Teflon rod flange seal requires no adjustment. Teflon bushing seal is shearproof. Teflon wiper keeps dirt out.

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Provide foolproof protection against seal failures resulting from rod damage. The Miller case-hardened rods (50-54 Rockwell C) give practically complete immunity to damage from hammer blows, wrench-dropping, mishandling, etc. The hard chrome plating over the case-hardened rods protects against scratch-damage and rust.

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Model "J"

PRICE SAVINGS OF 27% OR MORE!

19 mounting styles, all strokes, cushioned and non-cushioned. Large selection for immediate shipment.

BORE	SEVERE OPERATING CONDITIONS	MODERATE OPERATING CONDITIONS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
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50% More Power Per Cylinder Dollar!

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1½" through 12" bores, 17 mounting styles, strokes up to 22 ft., cushioned and non-cushioned. Large selection for immediate delivery.

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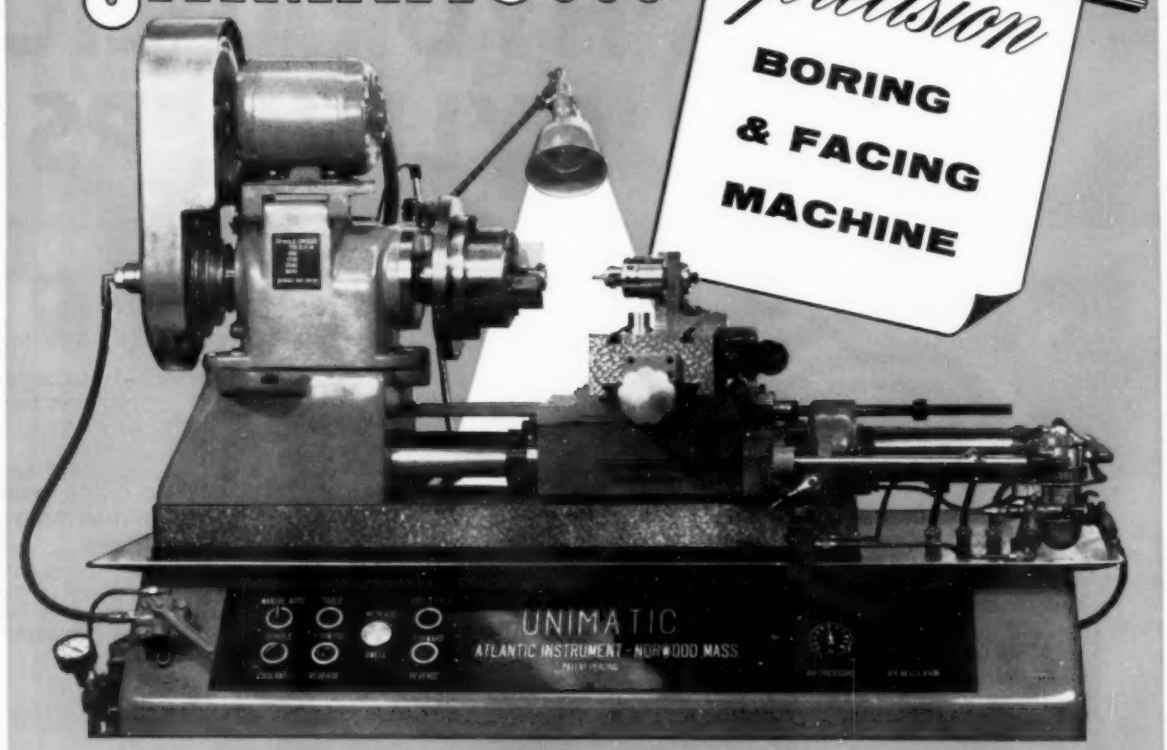

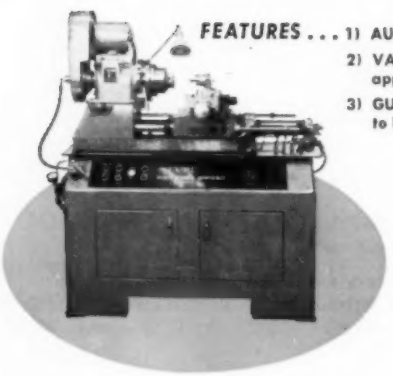

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3) GUARANTEED to hold work to .0002"

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The UNIMATIC *comprises an extremely accurate machine element, mounted on a granite base scraped to a tolerance of .00005", with other features (fully explained in our catalog) neutralizing the effects of temperature variations.*

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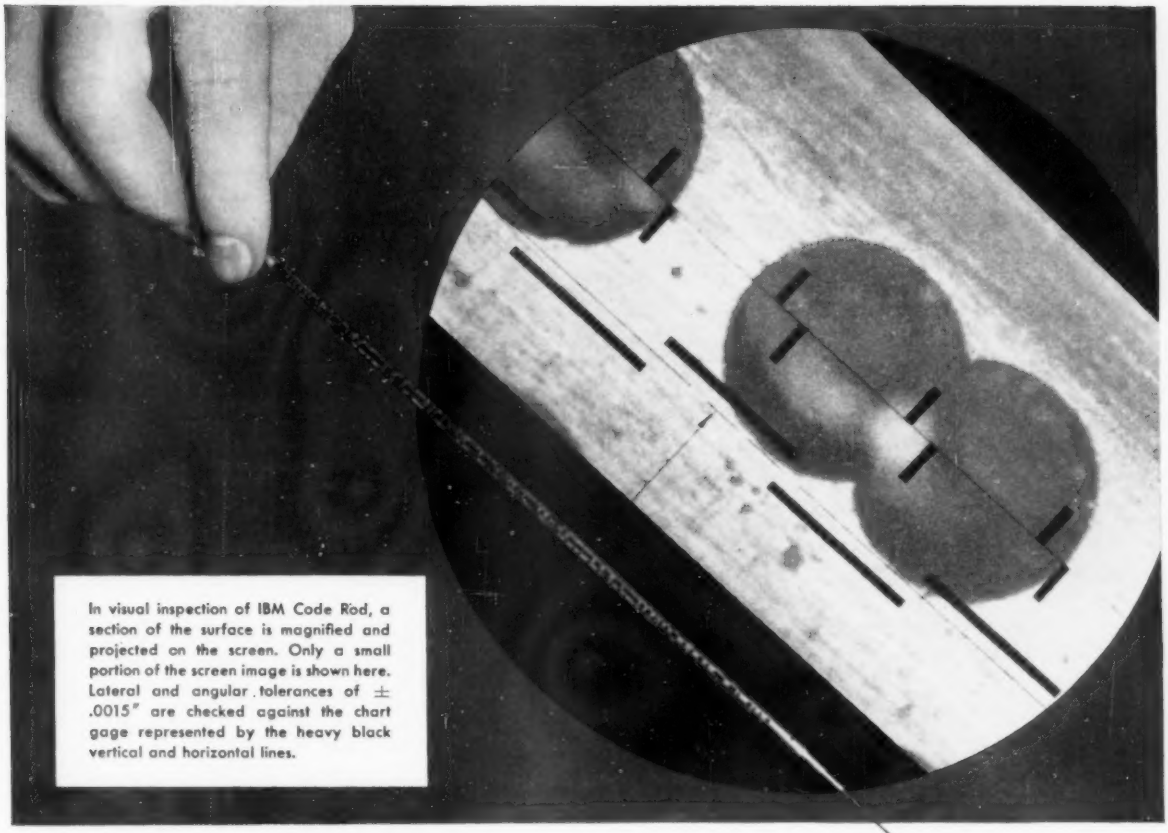


In visual inspection of IBM Code Rod, a section of the surface is magnified and projected on the screen. Only a small portion of the screen image is shown here. Lateral and angular tolerances of ± .0015″ are checked against the chart gage represented by the heavy black vertical and horizontal lines.

How would you gage these 1,118 holes?

Here's how IBM did it... and smashed an inspection bottleneck

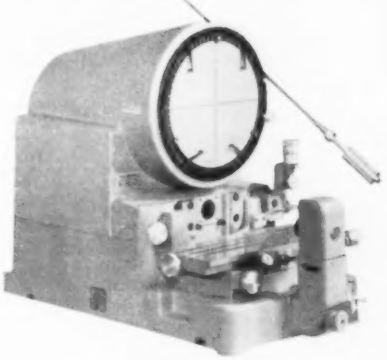
Here's how International Business Machines Corporation boosted the inspection rate on its new Code Rod from 1 or 2 *per day* to 15-20 *per shift*—keeping pace with production, yet maintaining complete accuracy—with a Kodak Contour Projector, Model 14-2A.

The Code Rod is used with the new 720 High Speed Wire Printer, developed by IBM to overcome the speed limitations of conventional bar type printers. The rod is a stainless steel tube with no less than 1,118 1/32″ holes. The holes are drilled in various combinations at 7 different intervals in 7 straight rows down the 8″ length of the tube. Obviously the inspection problem is of no small proportions.

Lateral and angular tolerances for the holes are ± .0015″. *To maintain these tolerances is critical because any mis-drilled holes would cause an error in the shape of the characters to be printed.* What's more, the 720 Printer operates at extremely high speeds, and any slight error could affect its operation.

In visual inspection a master Code Rod is placed next to the rod to be inspected. Both surface images are projected on the screen. The operator simply indexes the image along simultaneously, so that he always has a correct rod in view for comparison of the hole grouping. He checks tolerances by a chart gage on the projector screen.

Got an inspection bottleneck at your plant? Optical gaging with a Kodak Contour Projector may well be the answer. The booklet "Kodak Contour Projectors" gives examples of how other firms are profitably using Kodak Contour Projectors, plus full data on the various models we offer. The booklet is available on request from:



Kodak Contour Projector, Model 14-2A, is a versatile precision measuring instrument for production lines or toolroom. It is one of 6 Kodak Contour Projector models available to meet all your optical gaging needs. Operators work in complete comfort, need little training.

Apparatus and Optical Division

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

Kodak
TRADEMARK

School's Out!

Sure enough, another semester is back of us. All the students, instructors and professors are off for a long vacation. What a terrific waste of one of the nation's most valuable resources!

With the current accelerated scientific research and development in missiles and many other fields and with industry crying for more engineers and technicians, especially tool engineers, how can we afford to idle this educational training capacity for twenty-five percent of each year?

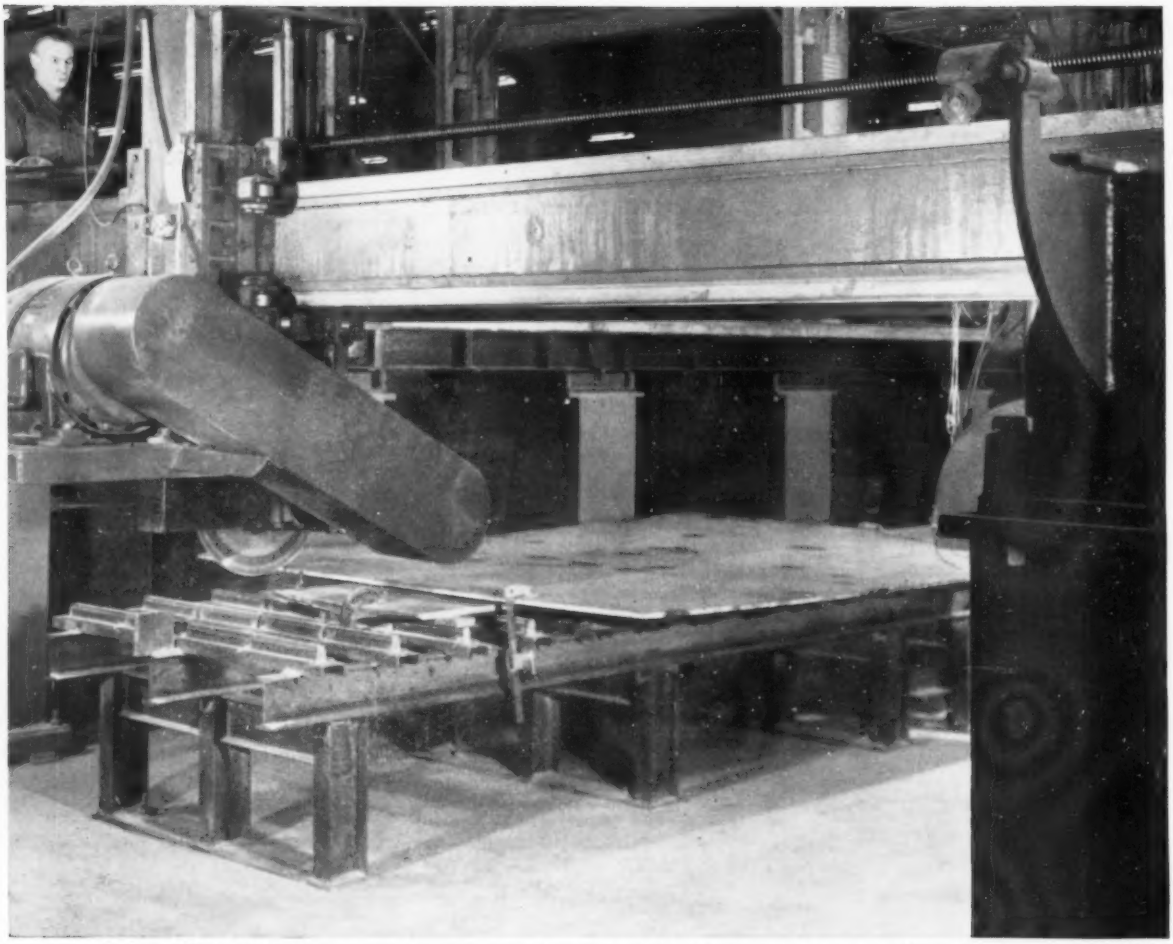
It would seem that plans might be devised to utilize these facilities for the special study courses which, under the present trend, are being dropped from the curriculum at many universities. The present tendency in engineering schools leans toward a concentration on basic science and engineering studies with increased emphasis on the humanities and social sciences. This means the elimination of many of the special courses so important to tool engineers.

Unless the demand from industry for men with this specialized training and the student demand for such curriculum becomes loud enough to be heard and heeded by our educators, we are sure to lose ground in our competition with other nations to maintain the highest standard of living. Our principal competitor is reported to be graduating more than five times as many engineers and scientists as we are. They are rewarding both students and instructors through an incentive system that produces results. If this continues, we can wind up in second place within a few years.

What can ASTE do about it? Now, there is food for thought. We invite the comments and help of every member.

G. A. Goodwin

PRESIDENT
American Society of Tool Engineers



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No wonder more people buy more stainless from Ryerson than from anybody else.

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organizing a Manufacturing Laboratory

By George W. Jernstedt
Director
Headquarters Manufacturing Laboratory
Westinghouse Electric Corp.
Pittsburgh, Pa.

With the pressures of competition, manufacturing research and development has taken on new importance. Manufacturing laboratories of the type described in this article are a significant investment in the future.

WITHIN A COMPANY having diversified manufacturing activities, a central manufacturing laboratory can serve a useful function. By coordinating endeavors of division laboratories and working on problems common to all of them, the central laboratory eliminates duplication of effort and directs energies of all facilities toward the most useful projects. With these facts in mind, Westinghouse management decided to establish a headquarters laboratory.

A previous laboratory of this type had been discontinued because a major portion of the work could be more effectively accomplished on a division level. Accordingly, it was considered essential to carefully study the role of the new laboratory in order to fit it properly into the organizational framework and realize the most effective operation.

Two years was spent on advance planning. Steps in planning included defining the purposes of the laboratory, determining the basic policies for governing day-to-day operation, finding suitably qualified personnel, selecting development work of greatest benefit to the most divisions, and designing and building the physical plant.

Purpose: The purpose of the laboratory was defined as " . . . to develop and improve manufacturing methods from a cost standpoint with due regard to quality of the product."

This laboratory is a staff organization designed to serve the needs of any division of Westinghouse. In order to limit the effort of the laboratory to that of creating new and improving existing methods and equipment, there are certain areas in which the divisions do their own laboratory work. Examples are: specifications, feeds and speeds, punchability, and machinability. These fields are sufficiently specific for a division to develop and carry out its

own programs, although it is possible that certain broad projects in these areas will be undertaken by the laboratory.

Operating Policies: In order to implement the purpose of the laboratory and define the working objectives, four basic operating policies have been established:

1. Interest divisions in establishing and maintaining their own manufacturing development programs
2. Employ the services of vendors as much as feasible
3. Disseminate information to the divisions using such tools as seminars, reports, internal publications and committee organizations
4. Establish forward looking manufacturing method and equipment development programs.

The product of a particular division is known best by its own people. A manufacturing laboratory established in a division has the advantage of proximity to the production line where benefits are gained from day-to-day experience in operations. Rather than limit the headquarters laboratory programs, such division organizations serve to uncover new areas which require broad development. In addition, developments emanating from a headquarters laboratory or an outside supplier stand a greater chance of being economically and technically successful if a division laboratory exists.

Before actually resorting to a laboratory hardware project, suppliers are consulted. If a supplier has already built a piece of equipment that will serve the need, the chances are the project will be more economical if the supplier's equipment is purchased. Further, with the many divisions in Westinghouse, it would not be possible for the company to design and build all new equipment and, at the same time, keep ahead of competition. Experience has shown that when a supplier has experience related to a particular application, and where his responsibilities are carefully defined, excellent results are obtained with purchased equipment. This applies to laboratory projects as well as those originating in the division.

It was recognized early that one of the most important services of the laboratory would be technical reports. A maximum return for a development made for a specific division can only be realized when findings are communicated to all interested divisions. When a particularly useful development takes place within a division, it is the responsibility of the laboratory to inform other interested divisions. Where specific action is required in an area involving a number of divisions, a committee is established for directing the work involved. An example of such a committee is the equipment development committee.

This committee, along with others of its type, serves as a formal meeting ground for those divisions having common problems. By means of regular meetings, development work, whether under-

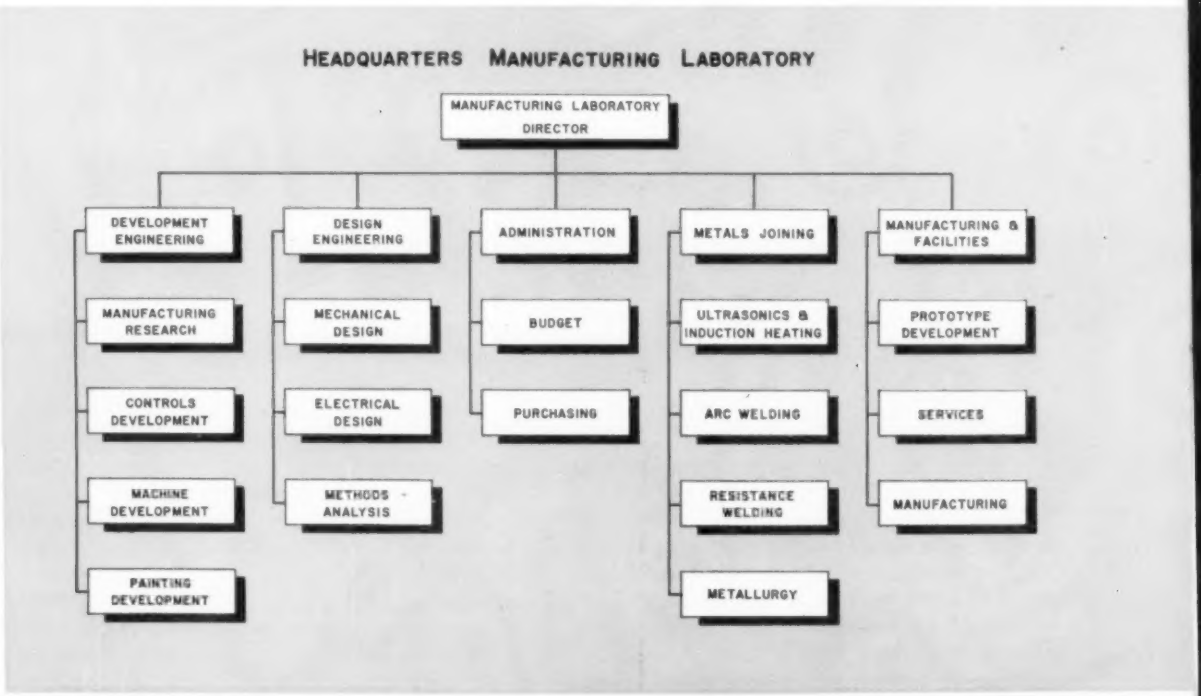


Fig. 1. Organization of Westinghouse Headquarters Manufacturing Laboratory. The flow of information is from research to development engineering, to design engineering, to manufacturing.

taken by committee members or others, is planned and coordinated to the best advantage of all.

When a particular problem is solved in the laboratory, the principles that have been established are applied first by the laboratory if possible. This application usually takes the form of construction of equipment to perform a manufacturing process or a prototype of such equipment.

Operating under these four basic policies, the headquarters laboratory is already beginning to meet the needs of the divisions. Growth will be permitted only as it is economically desirable and within the limits of the laboratory considered as a staff function. Projects are tackled on a "seed sowing" basis, that is, to provide new developments only, without duplicating equipment of established design.

Organization: The areas of manufacturing methods under consideration or study can include static devices, complex mechanisms, mathematical analysis and computer control. The staff members must be as well qualified as are the scientists and engineers who do research and development for product engineering. Previous manufacturing development groups had few college graduates and practically none with advanced degrees. In order to provide a staff with proper background and ability, job classifications exactly paralleling the product engineering groups in the engineering development and design groups were established.

This provided a basis for a gradual improvement in the quantity of technically trained personnel on manufacturing development projects. After the first year, the improvement in the quality of projects initiated by these technically trained people attracted additional personnel including several advanced-degree engineers.

Some special function laboratories were absorbed in the headquarters laboratory. This provided one source of experienced personnel. The major exception that was made in this regard was to integrate the metals-joining laboratory as a unit into the headquarters laboratory. This particular group had produced some of the finest developments in metals joining in the country and it was desirable to have it remain intact.

The laboratory organization in the final form is shown in *Fig.* 1. Looking at the chart, it can be seen that the flow of information within the laboratory is from research to development engineering, to design engineering, and finally manufacturing. Since it is the intention to construct only one machine of a kind, design is emphasized and given full stature along with development engineering.

A research group has been established for development engineering. Sometime in the future this group will probably be put on its own. Already the day-to-day problems are taking too much time of the research group.

A laboratory concerned with manufacturing development obviously requires extensive facilities. All of these facilities operate under the manager of manufacturing, since most of the facilities are already under his supervision and his reservoir of experience is invaluable.

Management Development: As soon as the organization began to take shape, it was realized that the group of management and supervisory people had never worked together as a team. One thing that was needed by all was training in management. When such a program was carried out the results were gratifying. Discussion meetings were held regularly on the broad areas of the management function. The topics were those that are

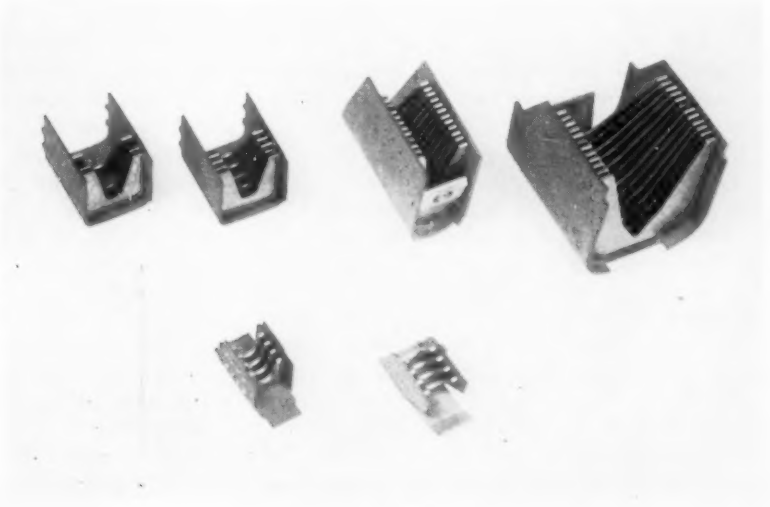


Fig. 2. Automatic assembly of arc chutes required research and development.

Fig. 3. Machine for assembling arc chute shown in *Fig.* 2.

not encountered in everyday work. The subjects included communications, supervisor's responsibility, salary administration, financial statements and control, union contracts, management counselling, business management, personnel problems, industrial relations policies and procedures, work-load organization and department procedures and paperwork.

The program was not a lecture course, although some specialists were brought in to assist in the discussions. Generally, the case history method was used. Each of the biweekly meetings was directed by one of the supervisors. Since the laboratory was new, the first topic was communications. The importance of keeping everyone informed of progress during this rapid growth period was stressed. All did some outside reading on the subject using Irving Lee's text, *Customs and Crises in Communication.*

Another very important subject was supervisor responsibility for people, letters, space, facilities, appearance and cooperation with parallel supervisors. An unusual point brought out was the recognition that there always will be a certain degree of overlap and it is essential to know when not to be sensitive to this condition. Of course, salary administration provided a good subject for discussion.

Programs: After the laboratory was organized and staffed, the matter of specific development programs was taken up. Although everyone was interested in automation related to mass production, it was recognized that the divisions needed help in mechanization of low-volume and job-shop operations as well. Work covered over a period of two years proved this to be one of the most important contributions of the laboratory. The possibility of solving problems in the laboratory and then not having the solutions being applied in the division was considered. It seemed advisable to stick close to actual division requirements and build up long-range new approaches to manufacturing problems gradually. Solution of specific problems allows the laboratory to gain direction and momentum without wasted effort.

Areas of study were selected that offered a general benefit to a number of divisions. Some of these areas are: painting, foil winding, automatic assembly, torch burning, machine tool control, sound analysis, automatic inspection, welding and ultrasonic methods. Most, but not all, programs have been successful. It is frankly recognized that when working in new territory, not all ventures will be successful.

Although design of specific equipment to improve the mechanization for a division is the immediate aim, some new principle or approach is attempted on each project. An example is a machine that was developed for the assembly of six styles of arc chutes, *Fig.* 2. This project was undertaken to provide equipment for assembling arc chutes and also to determine the effect of combining several styles of similar parts on one assembly machine, *Fig.* 3.

A project with the scope of the assembly machine provided a good training ground for this new group of people. It brought out the problems concerned with coordinating development, design and construction. Particular attention was given to a review with the product engineers to explore any foreseeable design changes. A sequential order of approach to tackling a project of this scope is now being studied.

A new laboratory building is being planned. All concerned with the use of the laboratory have been asked to assist in the planning.

The full potential and benefit of the laboratory have yet to be attained. As the project grows and matures it will become more and more useful in solving everyday problems and developing new production techniques.

Gadgets

Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work

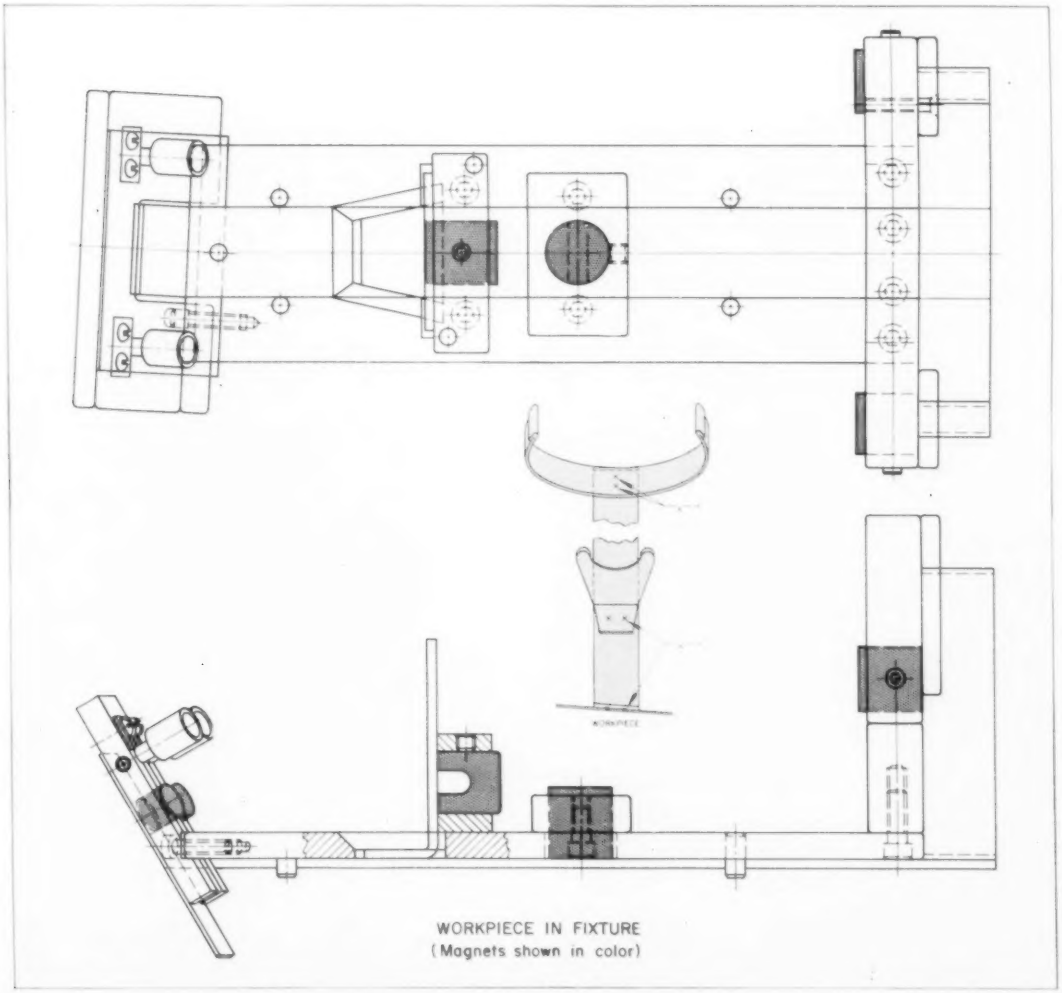
Magnetic Welding Fixture

When conventional hold-down straps and toggle clamps are utilized in welding fixtures, clamping is often time-consuming. To expedite welding operations in one plant, experimental production fixtures were built with permanent magnets taking the place of mechanical clamps.

The fixtures are fabricated from aluminum whenever possible, since the magnets should not be in contact with ferrous metals other than the workpiece. If it is impracticable to construct the entire fixture from aluminum, the magnets are inserted in aluminum blocks or bushings fastened to the fixture. In such cases, the magnets are held in the blocks by setscrews so they can be easily removed.

A fixture for welding a bottle-stand assembly is shown in the accompanying illustration. Fixtures of this type are easily fabricated, and greatly facilitate production welding operations. Permanent magnets can also be used to advantage in the design of assembly fixtures, drill jigs, locating fixtures and similar devices.

John E. Martyak
Binghamton Chapter



WORKPIECE IN FIXTURE
(Magnets shown in color)

Low-Cost Flycutters

Small contoured parts can be readily produced without expensive tooling. Simple flycutters of the type illustrated are capable of highly accurate machining when used with a conventional horizontal milling machine and work-holding vise.

The cutters utilize inexpensive ⅛-inch thick flycutter bits. These are held in a slot in a special flycutter arbor adaptor by means of two ¼—20 cap screws. Bits are of ground, annealed tool steel hardened to 64 R_C. Widths of the bit and the adapter are the same so that adjoining arbor spacers will prevent movement and accurate location settings may be secured.

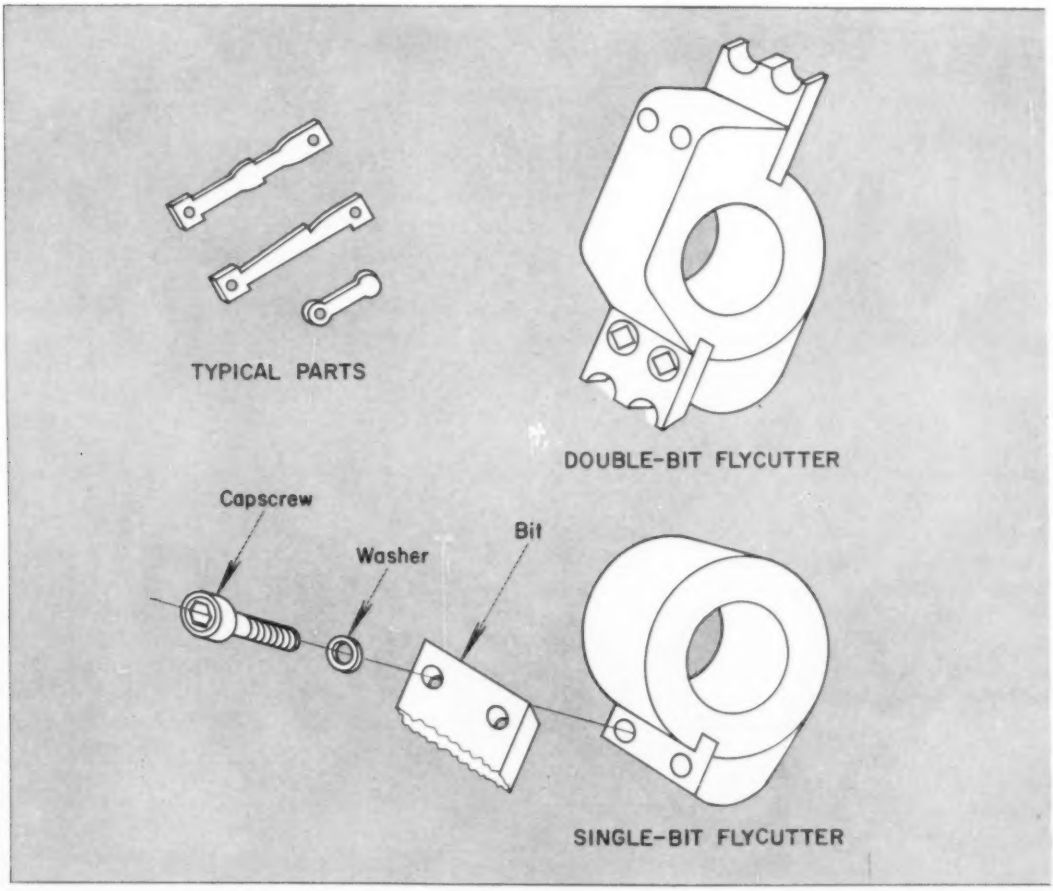
An adequate flywheel, mounted on the arbor and fitted as close as possible to the cutter is recommended. This will help to prevent chatter and "bounce" of the flycutter head at the time of cutter impact. Low speeds and feeds produce best results.

With this type of cutter, alloy steels, tool steels, stainless steels, brass, copper, aluminum, magnesium and plastics have been successfully machined. Material thickness has ranged from 0.015 to 0.312 inch. For improved finish and increased cutter life when working some of the tougher materials, a matched pair of roughing and finishing flycutters have yielded excellent results. A top rake angle of 5 deg or more, ground into the cutter bit face, is often included for increased cutter life and improved finish.

Use of a double-bladed flycutter head permits increased feeds and speeds and often results in better finishes and improved tool life. Tool cost is, of course, higher than with the single-blade cutter.

These low-cost cutters are capable of accuracies up to 0.001 inch. They are particularly suited for small production lots and model work where the use of standard tools is not economically feasible.

W. S. Mazar
Binghamton, N. Y.

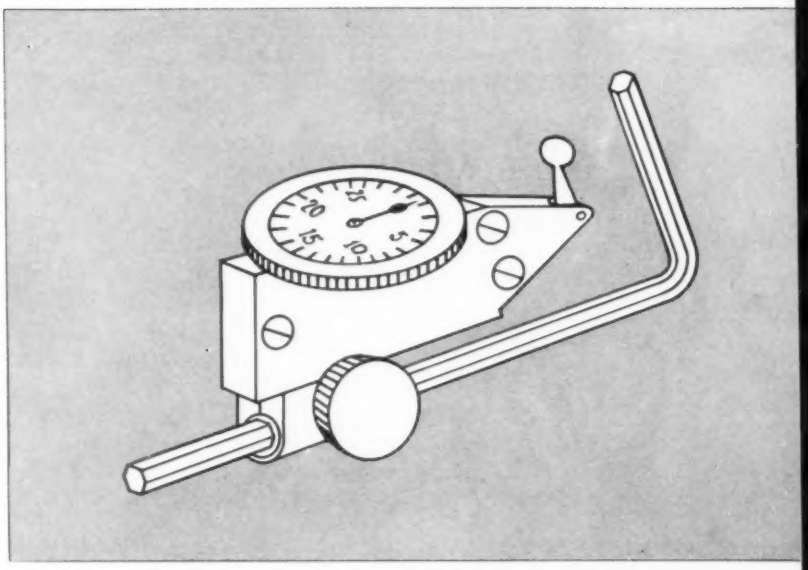


Improvised Comparator

When a comparator is needed in a hurry and none is available in the shop, one can be improvised by slipping an Allen wrench into a toolmaker's dial indicator as shown. The gage can be checked with a gage block or with a piece part of known accuracy.

For more accurate work, a better anvil can be made up, but for many rush jobs the Allen wrench is entirely satisfactory. This improvised comparator is also useful when taking measurements in a confined area.

Ernest Jones
Bronx, New York

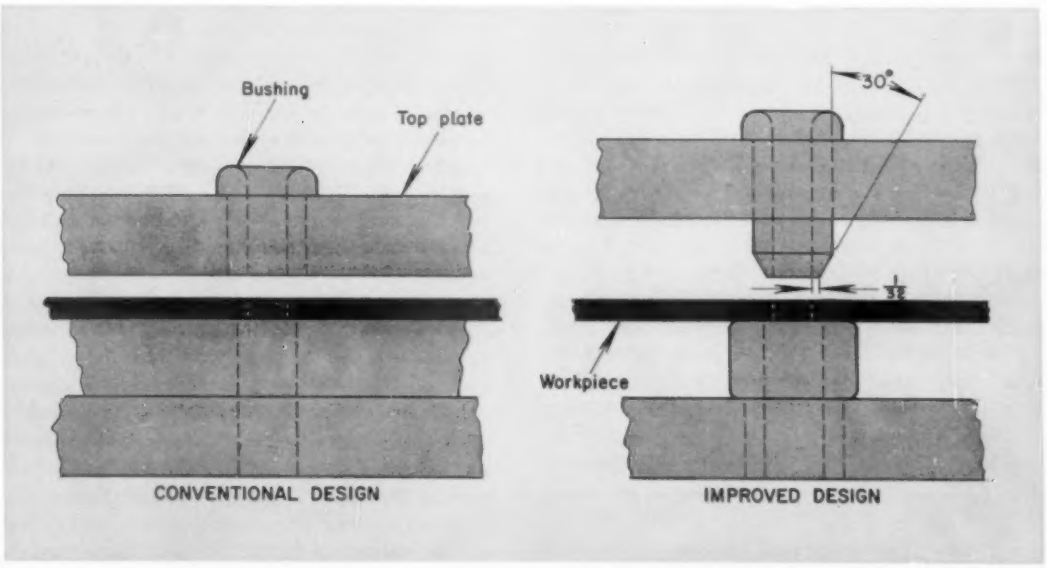


Drill Jig Design

Drilling efficiency can be improved by proper jig design. When drilling steel and other materials that form a curly chip, clearance between the top jig plate and the workpiece is particularly important. If clearance is small, forcing the chips away from the hole places an extra strain on the drill and causes heating.

In an alternative method of jig construction, greater clearance is provided. To maintain the desired distance between the end of the bushing and the workpiece, a long bushing is used. The actual distance between the end of the bushing and the workpiece is established by job requirements. Best results are obtained when the end of the bushing is tapered as shown in the drawing, giving additional chip clearance. Tests have shown that jigs of this improved design result in better drill life.

C. Andrews, Dayton, Ohio



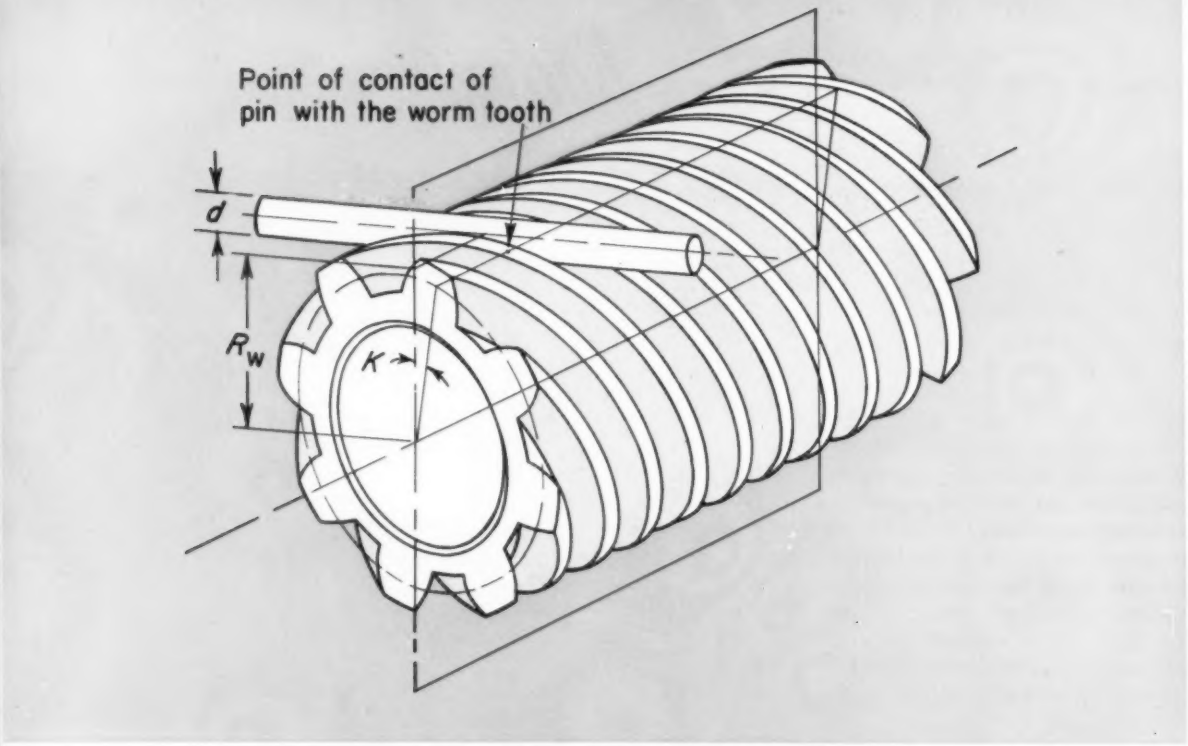


Fig. 1. Diagram of worm showing kernel angle *K*.

Over-Pin Measurements of Worms
...their practical limitations

By Louis D. Martin*
Gear Consultant
Rochester, N. Y.

In addition to acknowledging the scholarly work of two independent authorities, the author presents a simple approximate formula for over-pin measurement of worms. This formula yields results within practical limits affected by workpiece elasticity, measuring pressure, profile deviations and observational error.

*Senior member ASTE Rochester chapter.

PRACTICAL CONSIDERATIONS involved in measuring worms by over-pin methods have been overlooked in recent publications. These have discussed the theoretical aspects but have ignored the requirements of practice.

Calculation of exact values for over-pin dimensions of helical forms centers around the accurate determination of angle *K*, *Fig.* 1, which determines the point of contact of the pin. One authority calls it the "kernel" angle because it is the essence of the problem. Another authority calls it the "key" angle for a similar reason.

Exact determination of the kernel angle may be a laborious undertaking with a desk calculator. A series of 97 computations done three different times, totaling 294 stages, is required for the solution. It is suggested that the computations can be readily and quickly performed on an IBM type 650 computer.

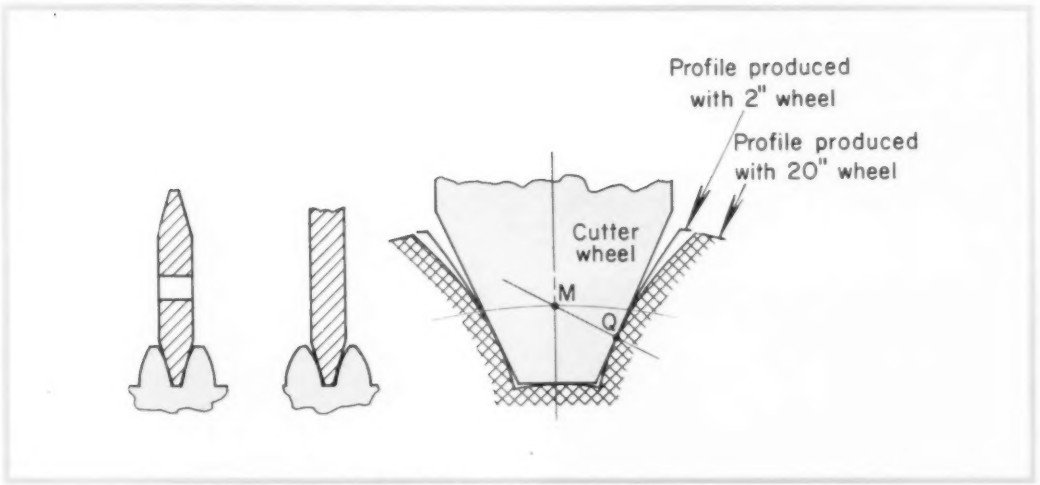


Fig. 2. (above) Variations in tooth profile produced with different diameter cutter or grinder wheels.

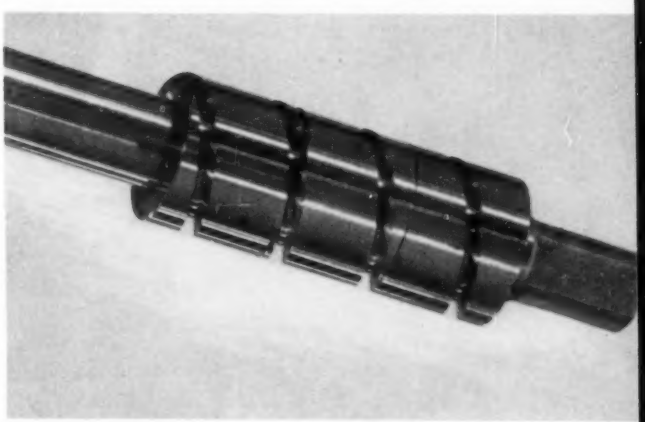


Fig. 3. (right) Test thread produced on three cylinders. Left cylinder is tool steel; center is cold-rolled steel and right is brass.

Such a computer, however, costs about $200,000 and is not found in many shops which have worm or screw problems. Furthermore, its operating costs have been conservatively estimated at approximately $75 per hour when all factors are included.

The second authority takes a somewhat more practical approach to the problem. He gives tables of close approximations to the exact solution. To fall within a certain strata of accuracy, it is necessary to consider an angle to 0.00008 degree. This is about 0.288 second. If this is not considered, an error in measurement on the order of 10 millionths of an inch on a four-inch diameter may result. Rules and guides for making amendments to the formulas are given to keep the key angle within acceptable bounds.

All these highly academic reasonings ignore considerations which greatly overshadow the exactness of the mathematics.

It is clear to people who have worked with pin measurements of gears and worms that, at best, all that can be determined by over-pin measurements is a knowledge of space width. This determination is based on a supposition that the exact pressure angle at the point of contact of the pin is known. In involute gears or involute helicoids there may be some basis for this assumption, although manufacturing variations and tolerances from the nominal profile should be considered.

In worms produced by a double conical wheel or cutter, the exact profile curve is determined by a given set of conditions. *Fig.* 2 shows how profiles vary in worm threads when produced by different size cutter wheels. This is from ASA Standard B6-9-1956 *Design for Fine-Pitch Worm Gearing*. The diameter of the cutter or grinding wheel is of paramount importance in establishing the exact profile of a worm. It is obvious, therefore, that if over-pin measurements of helicoids are determined to an accuracy of ten millionths of an inch, the profile shape on which the pin rests becomes critical. Now, it should be pointed out that every time the grinding wheel is dressed, or every time the cutter is sharpened, its diameter changes. When it does, the profile shape also changes. By the same reasoning a given pin measurement calculation is not valid because the profile changes due to cutter or grinding wheel diameter reduction.

The exact knowledge of tooth thickness on worm threads used to transmit power and motion is of secondary importance. Of far greater importance is conjugate tooth action. If a worm is not fully conjugate to its mating worm gear it cannot transmit uniform motion nor carry its computed load. In many fire control devices, for example, where spac-

ing accuracy is of paramount importance, the worm is spring loaded against the worm gear. It is common practice to grind the worm slightly oversize and lap it in on its final mountings in order to obtain satisfactory bearing.

One of the most accurate hobbing machines made is reputed to produce gears within five seconds of arc error accumulated in 360 degrees. In this machine the driving worm is held in intimate contact with its mating gear by springs. Exact size determination is of minor importance on this worm. Of far greater importance are lead accuracy, correct profile and elimination of drunkeness.

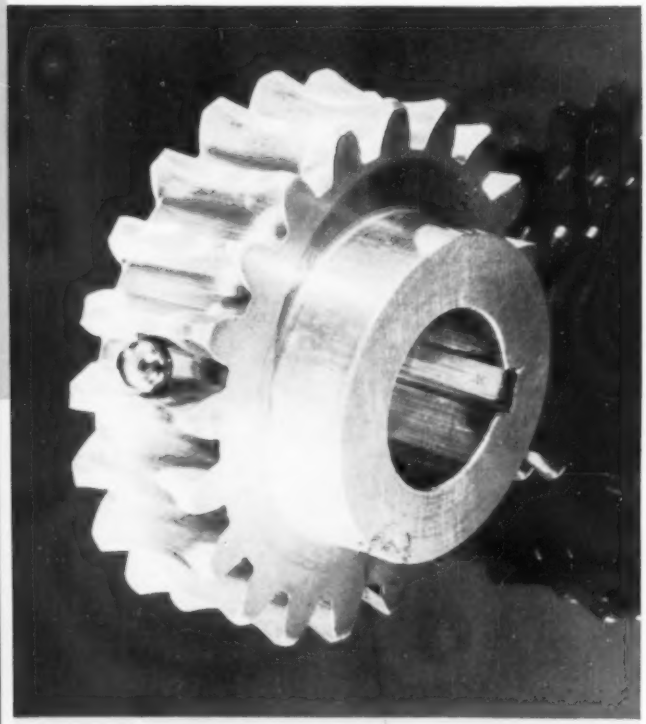


Fig. 4. Worm gear with ball for measuring.

The determination of size of either worms or gears by means of pins is, at best, an approximation. Although convenient because pins and micrometers are generally available, they have definite limitations. It is by recognizing their limitations that we can safeguard against erroneous conclusions. Pins ignore the influence of profile error, tooth thickness variation, pitch error, lead error and drunkeness. At best they enable one to determine the space width of a thread or gear at two points opposite each other.

Neither a thread nor a gear senses a size change in this manner. In the case of a threaded plug, a size change is sensed by the combination of a number of variables. The width of a space at two points determined by the contact of a pin is only one of the things to be considered in determining a truly functional size change. There are a number of cases on record where plug gages were checked by means of wires and certified to be correct where the gages, all of which were supposed to be alike, did not enter the same female thread gage. Likewise, there are innumerable cases of gears which supposedly checked correctly by means of pins which, when checked by means of a master gear or a mating member, did not agree with pin measurements.

A check of a threaded plug for size should include a check of all of the variables affecting size. Over-pin measurement should be supplemented by a functional check. In the case of a gear, the size change can be checked when meshed with another gear or master. In the case of a threaded plug, it can be checked with a ring gage or one of the modern checks which integrate the influence of the other errors.

The latest ASA gear standards, in referring to over-pin measurements, recognize their limitations. Whenever they appear, they are either labeled "Reference" or for "Setup Purposes."

Another important point has been completely overlooked in over-pin measurement of worms. Referring to the Van Keuren Co. Handbook No. 36-1955, *Precision Measuring Tools*, Item 4, page 197 of Appendix C states:

> DIAMETER OF WIRES. One set of wires shall consist of three wires which shall have the same diameter within 0.00002 inch (twenty millionths) and this common diameter shall be within 0.0001 inch of that corresponding to the best size for the pitch for which the wire is to be used. Wires shall be measured between a flat contact and a 0.750 inch hardened and accurately ground and lapped steel cylinder with contact pressure as follows: Wires for 60-degree threads in pitches finer than 20 threads per inch, 16 ounces; wires for pitches of 20 threads per inch and coarser, 2½ pounds; wires for 29-degree threads, 2½ pounds.
>
> It is recommended that wires which are used for the measurement of gears, splines, dovetails and other surfaces where the contact of the wire is a line contact, be measured between flat parallel measuring contact under a 1-pound load.

Nothing is said about the selection of wire diameter when used to measure helical gears, although this book has an excellent section on helical gears. From this information it can be deduced that:

1. Wires used to measure worms of 29 degrees included angle (14½ degree pressure angle) having an axial pitch of 0.050 and coarser are standard when measured under a 2½ pound load in the manner prescribed above.
2. A wire accuracy of 0.00002 inch is acceptable and expectable.
3. Wires used for spur gears are standard when measured between flats under a load of 1 pound.
4. A wire used for a spur gear cannot be used for a

worm or helical gear without some means of calibration.

5. A wire used for a helical gear of one helix angle may not be standard for another helix angle.
6. If the wire has been established as being standard when measured between a flat surface and a hardened and ground and lapped cylinder of 0.750 diameter, it may not be used to measure a nonferrous worm like brass, bronze or aluminum without violating the very conditions that made the wire standard in the first place.

One of the practical things of first order of importance that has been completely overlooked is the elastic deformation of the part being measured under the recommended measuring pressure of the wire. To determine this condition the author made a simple test. *Fig.* 3 shows three cylinders on an arbor. One of the cylinders is tool steel. The second cylinder is cold-rolled steel, unhardened. The third cylinder is brass. A thread was ground through the three cylinders which were treated as a single unit. The outside diameter was first ground accurately. The depth of the thread was such as would require a wire of 0.054 inch which is standard under a measuring pressure of 2½ pounds. The other pertinent data are: lead 0.390, lead angle 12 degrees, pitch diameter 0.531 inch, 20 degree pressure angle of grinding wheel.

In grinding the thread, a sparking cut was taken after the correct depth was reached. This sparking cut consisted of twelve passes of the grinding wheel without removing metal. This precaution was taken to insure identical surface conditions for all three members.

Over-pin measurement of each of the three cylinders was taken in a Pratt & Whitney measuring machine, first with the least pressure possible, namely ½ pound, and secondly with pressure increased to 2½ pounds. The difference between the first and second reading was: for hardened steel 0.0002 inch; for soft steel, 0.0002 inch; for brass, 0.00045 inch. The elastic deformation was proportional to the modulus of elasticity of the materials. For steel, $e = 30^6$ and for brass $e = 14^6$.

Can a meaningful size determination be made of the throated worm gear meshing the worm that may be theoretically accurate? The only way an equivalent size check could be accomplished is by means of a ball measurement as shown in *Fig.* 4. Remembering that a 0.054 inch diameter pin under a pressure of two pounds "Brinells" the surface 0.0002 inch per side, on a brass worm, it is not hard to imagine the greater elastic deformation that would take place if balls were substituted for pins. The other obstacle to overcome in obtaining an over-ball measurement would be the tendency for the balls to drift away from the exact midplane section of the gear. If this occurred, all of the pains in determining the exact over-ball measurement would be for naught.

In the art of precision measurements there is a threshold of uncertainty. The smaller the tolerance units, the broader the threshold becomes. As an example: If we want to measure an object within 0.001 inch, it is easily possible to do so within an observational error of 0.0001 or less. As the units become smaller the observational error becomes relatively greater and greater until it overshadows the tolerance we are trying to determine.

These practical considerations perplex people who are engaged in exact size determination of mechanical components. *Fig.* 5 shows the approximate relationships of observational error to size determination of over-pin measurements of worms. They are conservative and do not include all of the other variables which have to do with the exact knowledge of size. This diagram shows that a computed size knowledge of less than 0.0001 inch is unimportant.

What happens when key or kernel angles are ignored in over-pin measurements of worms? *Fig.* 6 is an approximate formula which has been used by the author for more than seven years. It is similar to formulas used for screw threads of low lead angles and has been compared for accuracy against pre-

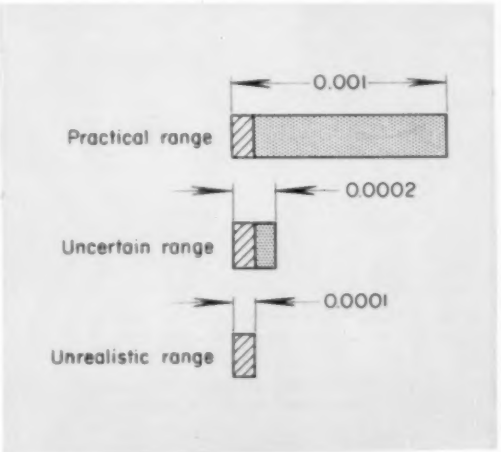


Fig. 5. Shaded area represents observational error pin measurament made with standard micrometer.

cision formulas in over two hundred cases. It has been found to be well within the bounds of observational errors.

Using this formula to solve an over-pin measurement problem for a borderline case, it would show a large discrepancy. For comparison, the problem will be solved in three ways: First, by using the approximate formula; second, by using the exact formula given in Van Kueren's handbook; and last, by considering the worm as a single tooth helical gear. It should be remembered that the profile shape of worms produced by a double conical cutter or grinding wheel, in either the normal or axial plane, is some kind of a curve. The assumption in this case

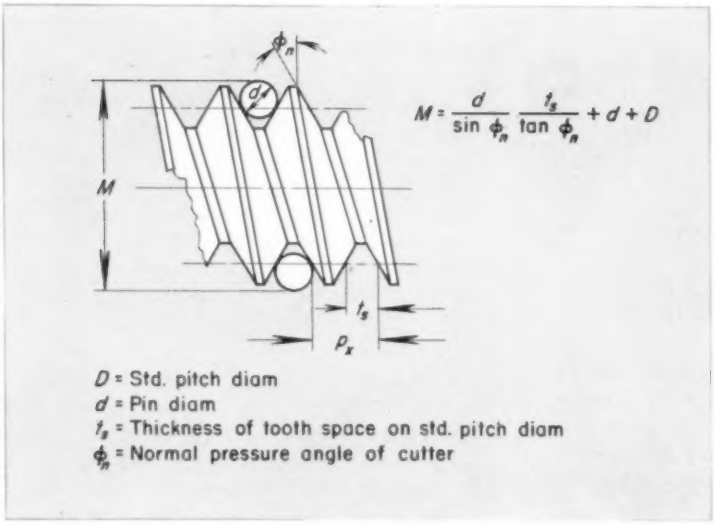


Fig. 6. Normal section of worm profile with approximate formula for pin measurement.

Comparison of Calculations for Worm

Method of Calculation	Over-Pin Measurement (inch	Calculating Time (minutes)
Simplified approximation	0.3753	3
Van Keuren's method	0.3751	60
Helical gear solution	0.3749	10

is that this curve approximates an involute curve. The data for the worm is as follows:

1 thread per inch
0.160 inch axial pitch
0.160 inch lead
20 deg wheel pressure angle
11 deg lead angle
0.262 inch pitch diameter
0.362 inch outside diameter
0.08387 inch pin diameter

Because the pin diameter had to be exact to fulfill the requirements of the Van Keuren system, we used the same pin size throughout. A summary of the results is shown in the accompanying table.

It will be seen that the approximate formula gives results within 0.0002 inch of Van Keuren's exact formula and within 0.0003 inch when the worm is considered as a single tooth helical gear having a helix angle of 79 degrees, which is complimentary to the 11 degree lead angle. The approximate difference in tooth thickness between the exact method and approximate method is considerably less, and is on the order of 0.00007 inch. In view of the inability to confirm or dispute the existence of an error of this magnitude, the simplified solution, which is twenty times faster than the shortest of the exact methods, should satisfy the needs of the shop and make over-pin measurements practical.

To summarize the case for a practical approach to this problem:

1. Over-pin measurements depend on a knowledge of surface geometry, which changes constantly as a cutter or wheel changes diameter by sharpening or dressing.
2. Pin measurements do not give a true check of size because they ignore all the other errors which affect size.
3. The application of checking pressure must be controlled closely and adjusted to each individual case of pressure angle and lead angle in order to be consistent with the procedures which make the checking wire itself standard.
4. The elastic deformation of the material must be considered and compensated for in order to meet exact requirements.
5. For the sake of consistency, the mating throated worm gear should receive the same attention in determining its size that is given the worm which meshes with it.
6. A knowledge of tooth thickness of a worm is secondary to a knowledge of profile shape, which is vital to its ability to sustain loads and transmit uniform motion.
7. Exact knowledge of over-pin measurements closer than the observational errors is not necessary. A close approximation is adequate and well within the ability of shop men to verify and apply.
8. A functional check for worms and gears has been found suitable for quality control. While the simplicity of pin measurements will always prove helpful in shop practice, their limitations should be recognized and final size determined by means of a mating member.

It is necessary to be practical and reduce production problems to a practical basis. Following the will o' the wisp in an endeavor to find that pot of gold at the end of the rainbow called "precision" may cause many disappointments. A safer course is to give due consideration to the practical limitations imposed by the necessities of production.

AUTOMATIC MACHINES for low-production parts

By Howard N. Maynard
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Automation need not be restricted to mass production. With the versatile equipment described by the author, many companies have found a new frontier for cost reduction.

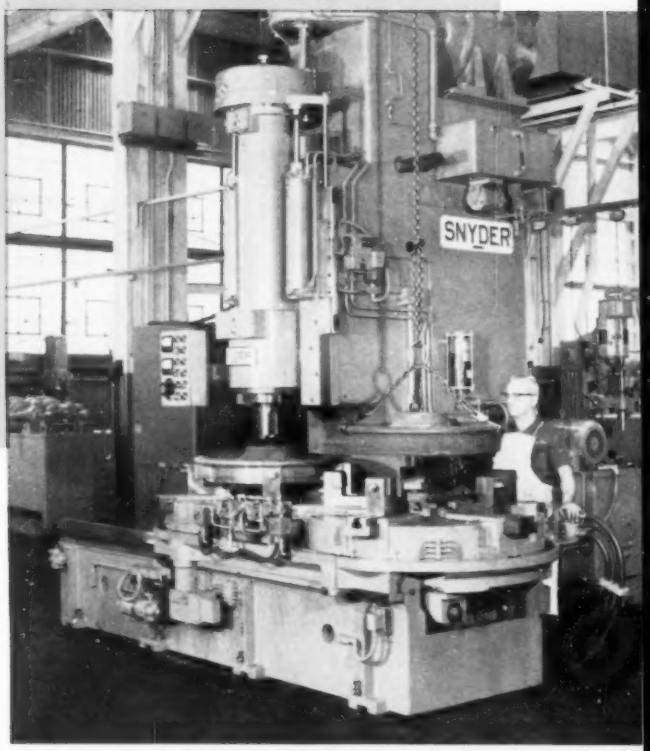


Fig. 1. Line-index type vertical boring machine that semifinishes a variety of railroad car wheels.

WHEN APPLIED to the production of high-volume parts, automation results in savings in floor space, improved efficiency, reduced part handling and greater accuracy as compared with conventional methods. These benefits can also be realized in the production of low-volume parts by utilizing automatic machines, *Fig.* 1, that make maximum use of interchangeable fixtures, fixture details and machining head details.

There are several types of automatic machines that are adaptable to low-volume production. These include combination-operation machines, double-end machines, line-index machines, trunnion machines and rotary-index machines. Each of these machine types is in successful production operation.

Combination-Operation Machines: In combination-operation machines, all operations are performed with the part held in a single fixture. Tolerance build-up due to varying fixture locations is eliminated and parts handling is minimized. The machine shown in *Fig.* 2, performs five complex operations on a jet engine front bearing support.

Basically, the machine consists of a way type machining unit with a vertical milling spindle and a 40-inch diameter index table, both mounted on a welded steel base. Table speed, vertical cutter travel and horizontal slide travel are controlled by stops on the periphery of the table. Thus it is possible to provide a number of cutter locations and

Abstracted from Paper 131, "Automated Special Machines for Low-Production Parts," presented at the 26th Annual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

to interrupt cuts and change table speeds by changing stops.

Cutter speeds are adjusted to tachometer settings by a variable-speed drive. Tool changes are simplified by a quick-change collet type holder. All tool setting gages are built into the work fixture, which is mounted on the rotary table. The floor-to-floor time to perform the five milling operations on each part is 50 minutes.

Double-End Machines: Milling, drilling, spinning, chamfering, facing, boring or centering operations can be performed on double-end machines. Parts are chucked between two machining units so it is possible to machine both ends of the part simultaneously. Interchangeable fixture details, adjustable or interchangeable heads, speed changing devices and adjustable stops are used to obtain the required flexibility. One such machine, now in production, can accommodate nineteen different transmission power take-off cases.

Line-Index Machines: Heavy or hard-to-clamp parts are usually produced on line-index machines. Parts are loaded in a fixture, indexed hydraulically in a straight line to positions between two or more machining heads and then indexed back to loading position. The line-index machine shown in *Fig.* 3 performs up to 40 drilling, boring, turning and tapping operations to complete the machining of three different lift truck drive axle housings. Fixtures are mounted on a rotary index table. This unit is carried in a line to six stations between a pair of opposed wing-base machining units. Where required, the table is rotated 180 degrees.

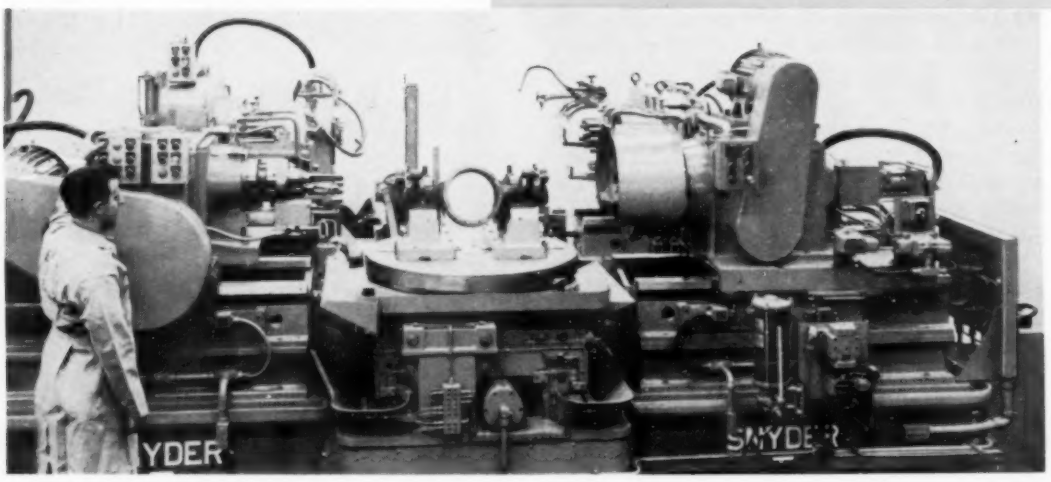
Pushbutton controls index the fixture between stations, rotate the table in accordance with a program sheet and cycle the machining heads. Quick-change adapters in certain spindles facilitate the 28 tool changes that are required to complete the machining of a part. One housing design is produced at a rate of 9.1 pieces per shift; the second at 10.2 pieces per shift; a third at 8.5 pieces per shift.

A machine for boring, drilling, chamfering and tapping track rollers for crawler type tractors also utilizes the line-index principle. Four different part designs are processed on this machine. Pot type interchangeable heads are provided for drilling, chamfering and tapping parts with different hole spacings and bolt circles. Release finger spacing and stops in the part transfer mechanism are also provided.

Essentially, this machine is a combination of a single-end boring machine and a line-index machine. Parts are loaded in a gravity type transfer mechan-

Fig. 2. (left) Combination-operation milling machine for an aircraft jet engine front bearing support.

Fig. 3. (below) Line-index machine for processing a variety of lift truck drive axle housings.



ism, and roll into boring positition, *Fig.* 4. Finish-bored parts are transferred to the fixture in the line-index machine by a hydraulic-cylinder operated transfer mechanism, *Fig.* 5. Then the fixture is indexed in sequence to the drilling, chamfering and tapping positions. At the completion of the tapping operation, a finished part rolls out of the fixture, *Fig.* 6, and the fixture returns to its initial position.

The use of the three-station index machine makes possible a balanced-cycle sequence in which drilling, chamfering and tapping operations are carried out during the hole boring operations. Rollers are produced at the rate of 38 per hour.

Trunnion Machines: In trunnion machines several workholding fixtures are mounted on a vertical table or trunnion between opposed machining heads. The fixtures are indexed hydraulically from one station to the next. All machining operations are performed simultaneously and a finished part is produced with each index of the trunnion. Loading and unloading of the workpiece is accomplished while the machining operations are being performed. If necessary, machining operations can be performed from the periphery of the trunnion fixture. Interchangeable fixture details and pot type heads in the machining units provide flexibility.

A typical trunnion type automated special machine is shown in *Fig.* 7. Work fixtures in this machine are mounted on a trunnion that is indexed to five positions between opposed way type machining units. This machine drills, core drills, reams and taps four different groups of more than 58 coal mining machine rock bit holder details. Workpieces are indexed to five positions between two opposed-way machining units.

The parts processed on the machine vary in size and shape, number of holes, hole locations and hole

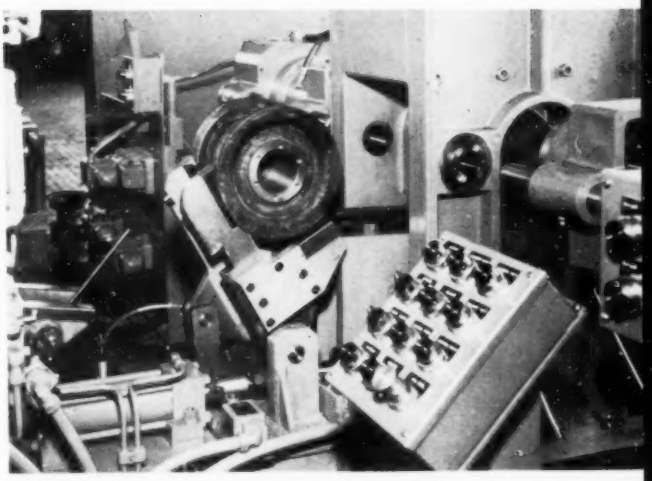


Fig. 5. Transfer of part between boring machine and line-index fixture. All operations are automatic.

sizes. Part size and shape variations are taken care of by interchangeable fixture details. Hole number variations are accommodated by utilizing two-position fixtures. Three interchangeable two-spindle pot heads on each of the main machining heads provide for variations in hole location. Tools are mounted in adjustable adapter assemblies. This makes it possible to quickly change over to different hole sizes and lengths when required. Production is 25 pieces per hour.

Rotary Index Machines: Another type of automated special machine that is adaptable to low-volume production is the rotary-index machine. Machines of this type have low floor space requirements. Part holding fixtures are mounted on a horizontal table that is indexed from station to

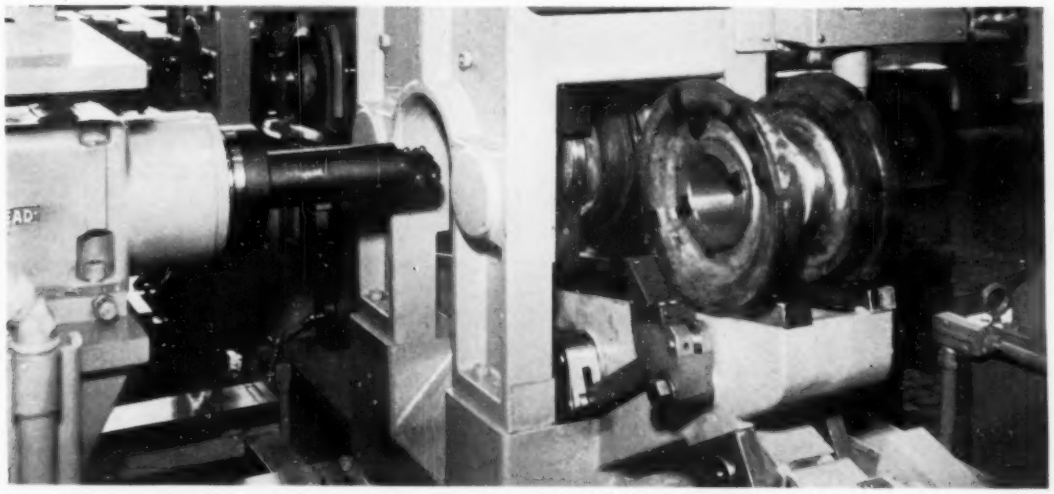


Fig. 4. Tractor track roller in loading position in combination boring and line-index machine.

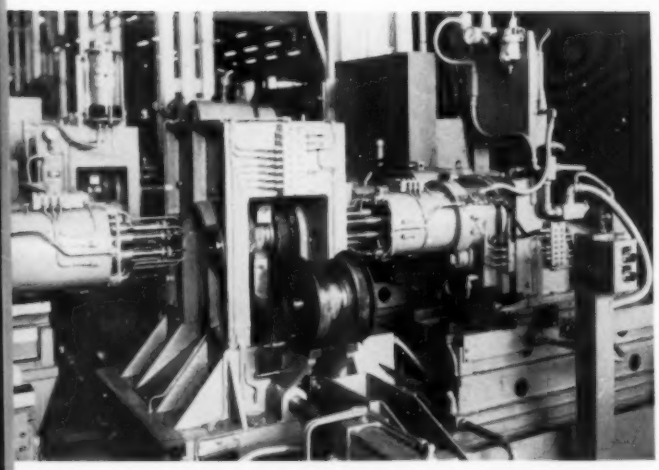


Fig. 6. (above) Unload station of combination boring and line-index machine for track roller production.

Fig. 7. (right) Trunnion type machine for processing coal mining rock bit holder details.

station, positioning the parts in front of radial, horizontal or vertical machining units. It is possible to clamp two parts in different positions on each fixture to present more parts for machining. Loading and unloading is accomplished during the machining cycle and a finished part is produced with each index.

One rotary index machine that faces, bores counterbores, undercuts, drills and chamfers more than fifty different universal joint flanges produces up to 96 pieces per hour. Machine flexibility is provided by interchangeable fixture details, drill heads and cutting tools.

Special Industry Machines: Many specialized industries requires machines embodying automation concepts for low-volume or variety production lines. The railroad industry in particular has utilized the flexible-machine automation concept.

Car wheel boring operations are performed on several sizes of wheels with a wide range of bore size requirements. The machine illustrated in *Fig.* 1 is a special vertical boring machine which makes use of line-index methods to speed output. A car wheel is loaded in a two-position fixture while another is being bored. Then this part is indexed to boring position and the finish bored part is un-

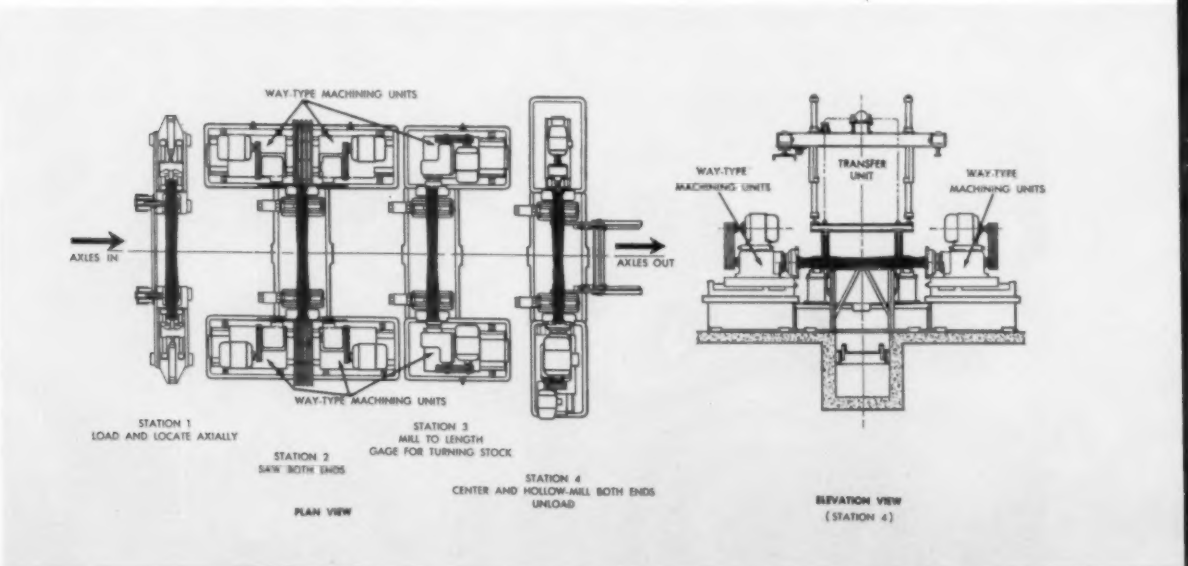


Fig. 8. Line type cutoff and centering machine for railroad car axles.

loaded at the other side of the machine. Wheels are loaded alternately at each side of the machine.

The operation shown is a semifinish boring operation on a rough-forged or cast hole in the steel wheel. Up to $1\frac{1}{16}$ inch of stock on a side is removed in a 70-second machining operation.

A variable-speed drive provides the spindle speed variations needed for boring the different hole sizes at a 225-fpm cutting speed. Interchangeable boring bars with mechanically clamped, throwaway carbide inserts provide hole size flexibility.

Railway car axles are machined in a variety of lengths and journal diameters. The machine shown in *Fig.* 8 is a four-station transfer type machine that saws both ends, mills to length, hollow mills one end and center drills both ends of the axles. An overhead transfer mechanism picks up the parts at the loading, first and second machining stations and carries them to the succeeding operation.

A variety of axles are accommodated in this machine by changing head positions, fixture jaws, transfer mechanisms and tools. Axles are produced at rates up to 36 pieces per hour.

Another industry that is making significant cost savings through the use of automation concepts in low-volume production operations is diesel engine manufacture. One of the production problems is milling connecting rods and pistons to precision balance or weight specifications. A variety of parts of varying sizes and materials must be handled.

The connecting rod balancing machine shown in *Fig.* 9 handles connecting rods from $7\frac{3}{8}$ to $12\frac{1}{2}$-inch center distance. The machine is made up of three individual units: a milling machine with opposed double-spindle heads, a console containing all operating controls and a precision weighing unit. Wedge stops on the milling machine units are automatically set to within 0.001 inch by a device that "remembers" weight measurements. The weighing operation can thus be carried out while a rod is being milled to balance specifications.

Fixture and clamp details are changed to accommodate the different parts. The weight scale is individually calibrated to suit different rods.

Building Block Components: All of the machines illustrated make extensive use of standardized components.

The most common building-block unit is a standard-design cast-iron machine base with removable hardened-and-ground steel ways. The top of the unit is keyed in two directions for the mounting of a motor and head unit for machining operations. A hydraulic cylinder that moves the slide back and forth is mounted in the base. Hydraulic power for these way type units is provided by a separate motor, pump and tank unit.

Standard-design tapping heads are often mounted on way type units to make a completely automatic

Fig. 9. Connecting rod balance-milling machine precision-balances several part designs automatically.

"building-block" machine. These heads have individual leadscrew drives for each spindle.

Some standard machining units are self-contained. Separate pump and tank units and related external piping are not required. The units, which have cast-iron bases with replaceable hardened-and-ground steel ways, contain integral hydraulic power systems, including tanks, cylinders, pumps and electric motors. Drill heads, boring heads and related machining components are bolted to the front of such units. All hydraulic control components including valves, control panels and stops are mounted on the sides of the units.

Indexing mechanisms for trunnion type and rotary-index machines are also standardized designs. Standard trunnion index mechanisms use the same basic type of system as the rotary index type. A separate hydraulic cylinder operates the index pin and thus can be located near the trunnion periphery for maximum accuracy. In rotary index tables, the shot pin is mechanically actuated.

With this wide range of proved standardized types of special machines as well as standardized machining units and index mechanisms, plants with low-volume production can now realize the full benefits of automation.

Importance of Tool Engineering

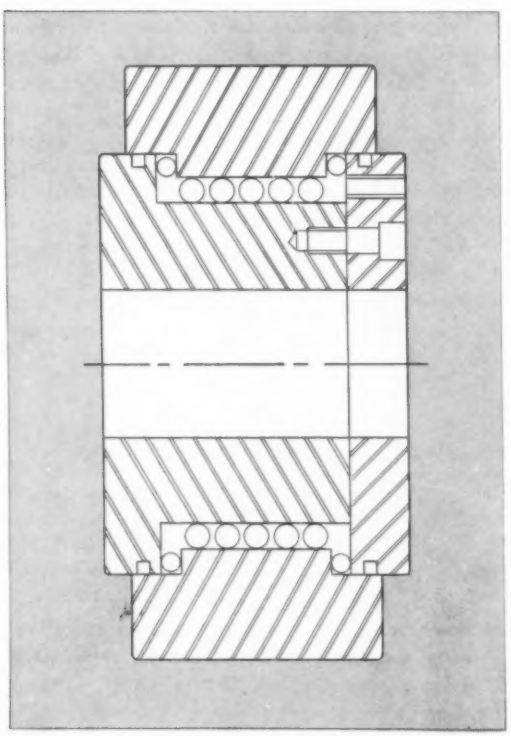
Tool engineering is now reaching into the new nations created after World War II. This proves again that industrialization must begin and does begin with tool engineering.

Take the tool engineer out of industry . . . what do you have left? Mostly black pencil lines on white drawing paper and no one to convert engineering ideas into reality.—*Max Kronenberg, Consulting Engineer, Cincinnati 6, Ohio.*

designed for
PRODUCTION

Special Tooling Converts Conventional Machine for Contour Milling

MACHINING a swarf contour on SAE 4130 steel parts presented a tooling problem at Chance Vought Aircraft, Inc. It was solved by changes in the tool setup using a special milling cuttter gang, designed by Goddard & Goddard Co. A special head and auxiliary equipment adopted a standard horizontal milling machine to permit close control over table rise and fall. Other changes were needed in tool angles and templates of the contour.

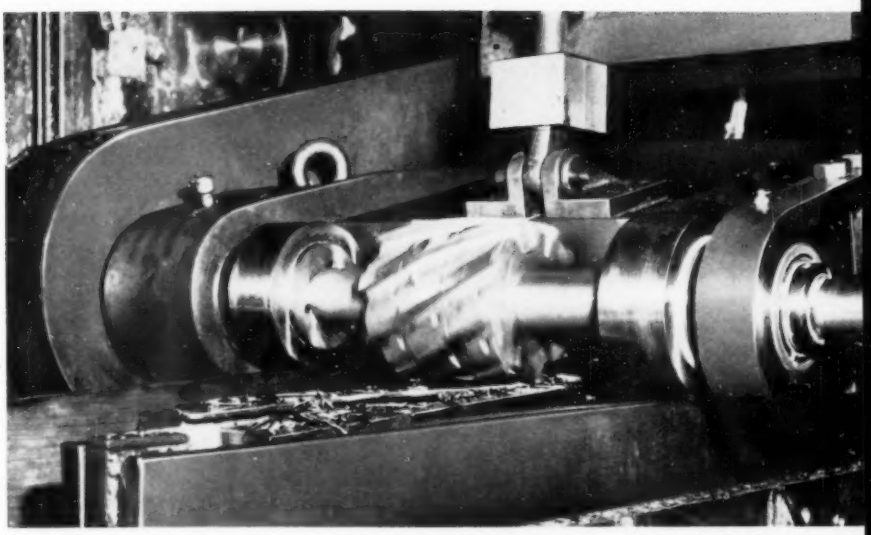


CROSS SECTION of the special follower bearing. Balls in race recesses take up side thrusts during machining.

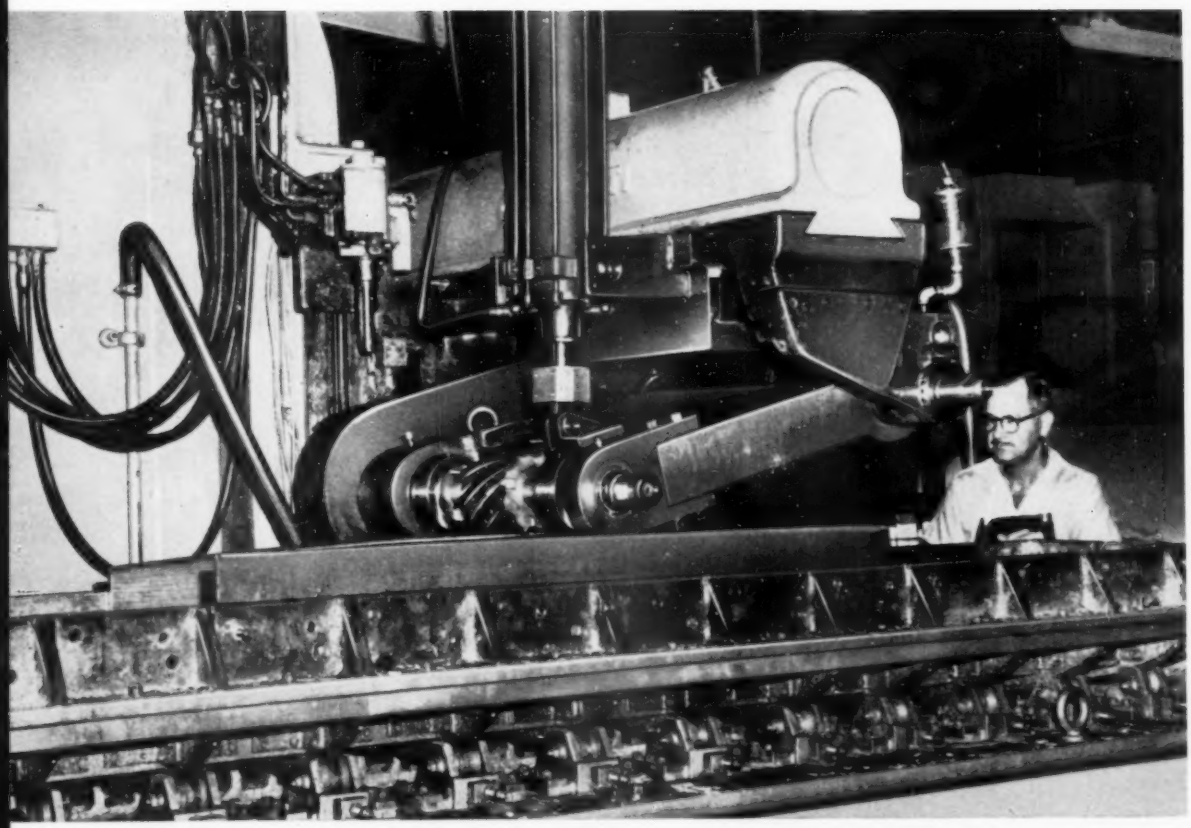
Guide bearings, which pilot the cutter gang over the contour were changed from the conventional to a special design. In operation, the outer race of the bearing rolls on and travels over the templates, while the cutter is taking an 0.030-inch depth of cut at a 4-ipm feed at 280 fpm. The inner race of the bearing is keyed to the cutter arbor and turns at the cutter speed. The outer race turns only the feed rate.

To obtain maximum feeds and speeds, the cutters are manufactured with true helical inserted carbide-tip blades. The helical design permits a progressive tooth entry into the work. For control purposes, diameters of the cutter and guide bushings are held in close relation. The design of the inserted blades and cutter body with serrations on the mating surfaces aids in maintaining the cutter diameter relative to the bearing size. When the blades are worn beyond the allowable limit, they are moved up one serration and the cutter is resharpened to the desired diameter.

Cutter, bearings and arbor assembly are mounted between two extended pivot arms attached to the standard machine overarm. A belt from the machine spindle drives the cutters. As the table holding the parts moves into the rotating cutters, the entire unit swings freely, reproducing the contour. A pressure cylinder coupled to the extended pivot arms supplies a downward force to keep the cutter from climbing up and running over the work.



SPECIAL milling cutters taking a 0.030-inch depth of cut at 4 ipm. Bearings on the arbor follow contour guide templates and control cutters relative to the workpiece.



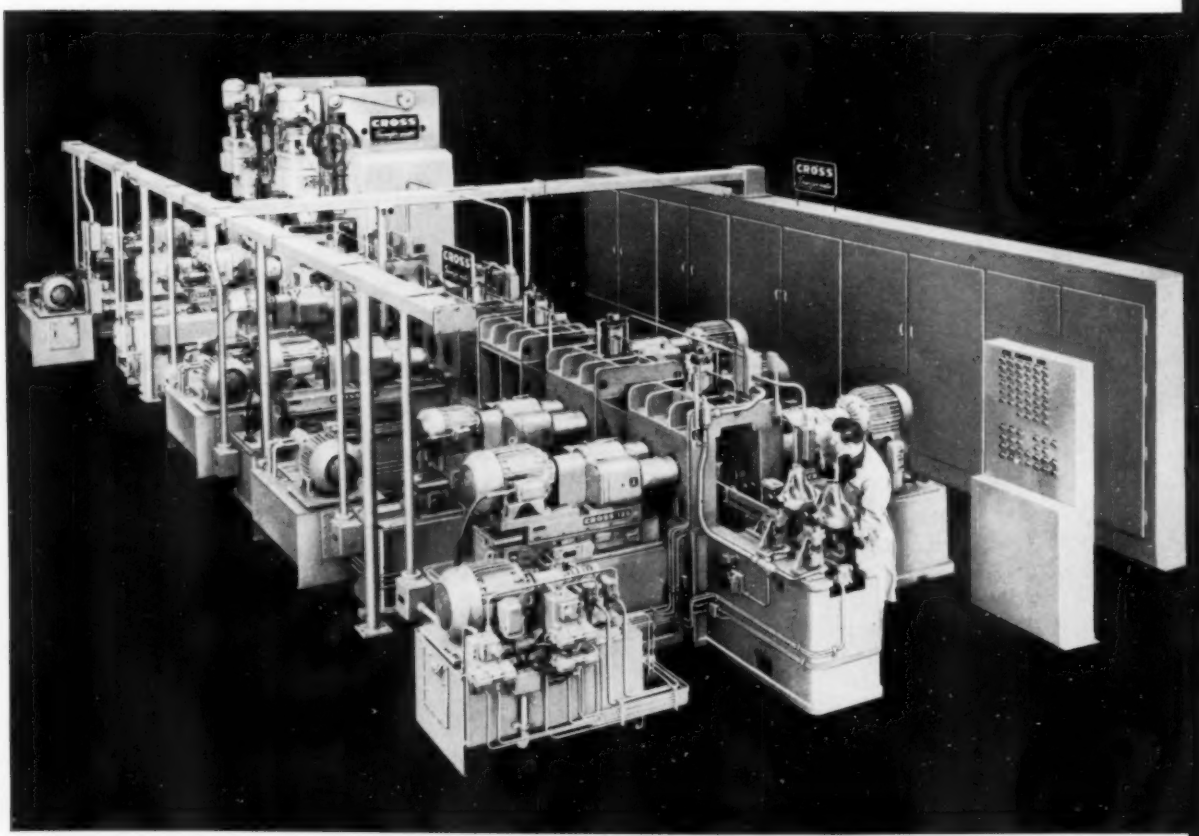
TOOLING SETUP used in simultaneously machining a swarf contour on two SAE 4130 steel parts. Pressure cylinder to keep bearing rollers in contact with templates is seen at the top.

Transfer Machine Solves Concentricity Problems

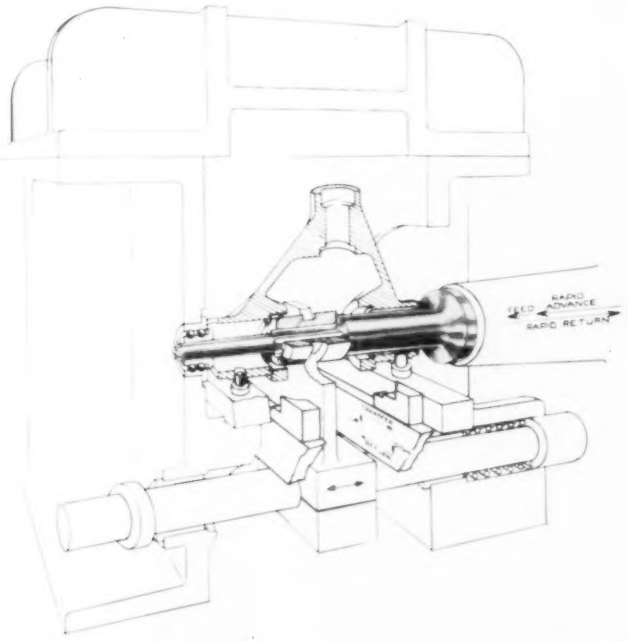
BEARING bores and shoulders of automotive axle housings must be concentric and square to assure alignment of shafts with gear mounting holes. A transfer machine developed by the Cross Co. accurately rough bores differential bearing diameters and finish machines bearing bores using conventional boring tools.

The cutter for rough boring the differential bearing diameters is loosely supported on a blade-like bearing. When the part is located in the boring station, an arbor picks up the boring tool on a splined shaft to start the boring operation. The end of the arbor is supported by an outboard bearing during machining to assure proper location of the cutter head.

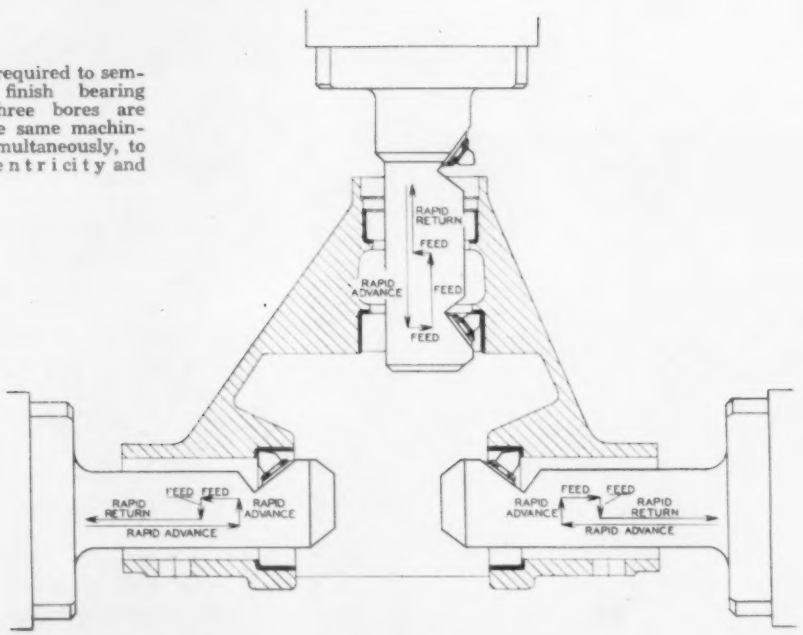
Finishing operations are performed by a vertical boring unit which faces the shoulder and then bores the diameter for the outer pinion shaft bearing. Then the diameter and the face of the shoulder are bored for the inner pinion shaft bearing. Concentricity and squareness of shoulders are obtained between the two bearing bores since both operations are performed by the same spindle. Two opposed horizontal units back-bore the differential bearing diameters to insure precise center relationships in the finished part.



TRANSFER MACHINE for finishing operations on rear axle housings with the differential bearings caps assembled.



CROSS SECTION of rough boring station for machining the differential bearing diameter. Tool motions and transfer bar operations are shown by arrows on each element. Blade bearing supports cutter head when not in machining position on the splined spindle.



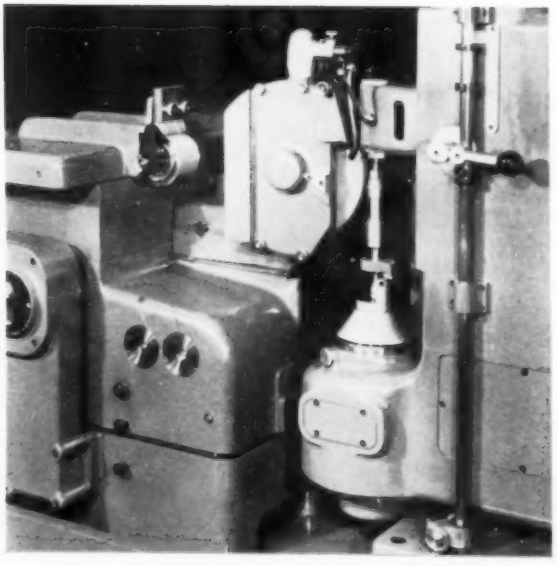
TOOL MOTIONS required to semifinish and finish bearing bores. All three bores are finished in the same machining station, simultaneously, to assure concentricity and squareness.

DESIGNED FOR PRODUCTION

Crank Reduces Grinding Time

BY THE addition of a hand crank to the table feed of a standard grinder, manual feeding of the workpiece is facilitated. It is possible on the Brown and Sharp grinder for the operator to reciprocate the table without having to assume an awkward, unnatural stance while grinding. With this crank, he can easily observe the grinding wheel's action on the workpiece. For convenience of the operator, the crank may be placed in any position such as shown in the photograph or in a horizontal position so that the motion can be up and down.

Gears Ground from Blanks



WITH a gear grinder produced by Coventry Gauge and Tool Co., Ltd., gears with a 200 diametral pitch are being produced from hardened-and-ground blanks.

The machine is a continous indexing type, using a grinding wheel similar to large diameter hob or worm. The basic rack form is incorporated into the periphery of the wheel by crush rolls. Feed per revolution of the work varies from 0.001 to 0.012 inch. Maximum blank diameter is six inches, and maximum face width on which teeth can be ground is three inches.

A number of gears are ground in the same setup as illustrated in the photograph. The grinding station for gear generation is located at the right, and the crush roll is on the left.

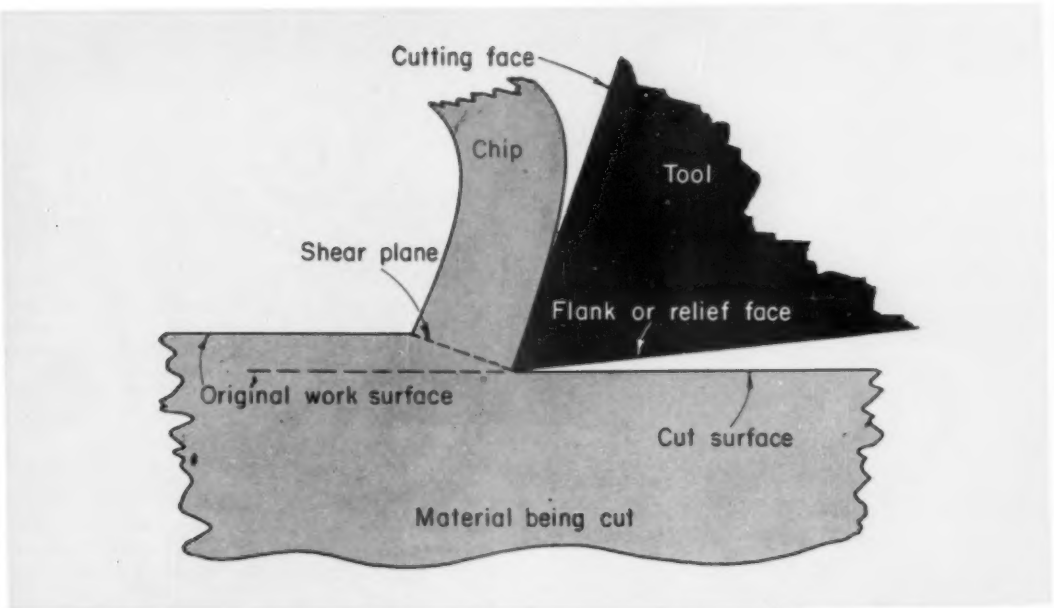


Fig. 1. Cross-section representative of cutting of ductile metals in almost all types of operations which form chips. Wear on either flank face or cutting face or both lead to almost all types of tool failure.

controlling TOOL LIFE

By L. V. Colwell*

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Many factors affect tool life. The author shows what these factors are and suggests a simple formula for determining optimum life.

*Senior member ASTE Ann Arbor chapter.

Abstracted from Paper 53, "Tool Life," presented at the 26th Annual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

To the practical tool engineer tool life has many distinct and different meanings. It has the same meaning to everyone in the sense that it is the time during which a tool cuts satisfactorily. The satisfactory cutting period may be determined by factors such as surface finish, size control, rate of cutting and economics.

How Tools Wear: Breakage is not responsible for many tool failures since most cutting tools are replaced before breakage occurs. The majority of the work required to cut metal is converted into heat at the shear plane, *Fig.* 1. Heat ultimately determines the rate of tool wear which in turn determines tool life.

At low cutting speeds there is at least as much heat generated as at high cutting speeds. However, the heat generated in the shear zone is absorbed by by the workpiece, cutting tool and the chip; consequently, temperatures are relatively low. At high speeds the short contact time of the tool with the workpiece does not allow significant heat transfer so the work remains relatively cool and practically all the heat goes to the chip and the cutting tool.

Heat is produced at the chip-tool interface due to the rubbing of the chip across the tool. The heat generated here is caused by friction which depends on work material strength, tool roughness, lubrication and total contact area. When cutting at low speeds with high-speed steel tools, a built-up edge

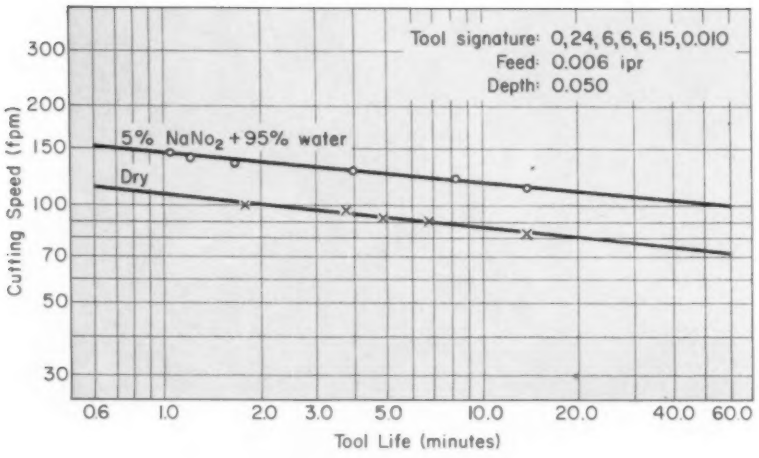


Fig. 2. Typical tool-life lines based on total tool breakdown. Relatively flat slope indicates high sensitivity to temperature. Data shown are for turning cuts in a lathe using high-speed steel tools to cut a titanium alloy.

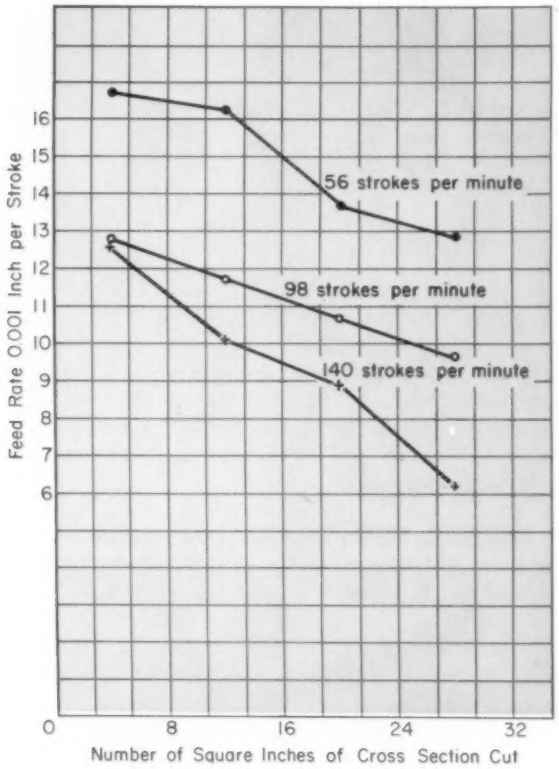


Fig. 3. Effect of cutting speed (area sawed) on feed rate for power hack-sawing. Tool life is determined by reduction of the feed rate to an uneconomical value. A hydraulic-feed, six-inch stroke machine was used with 6-pitch, 14-inch-long blades. Stock was 2x4 inches in cross-section. Cutting fluid was a 1:20 emulsion of soluble oil.

is formed near the nose of the tool. The angle of the shear plane is relatively small, resulting in a thick chip and large tool-chip contact area. The built-up edge has a beneficial effect in that it tends to protect the tool against high temperatures by shifting the maximum temperature away from the cutting edge; however, at the new maximum temperature point cratering occurs. The crater becomes progressively deeper until the point of the tool breaks off.

A built-up edge usually extends beyond the flank or relief face of the cutting tool so that when it is present it also reduces wear on the tool flank. When it is not present, wear which gives rise to tool failure occurs in this zone. This is the case in cutting all abrasive and brittle metals like cast iron, and also when cutting ductile metals under conditions where a built-up edge does not form on the tool. Wear on the tool flank is more significant than on the tool face. Flank wear provides most of the different bases for determining tool life.

Total Tool Failure: Total tool failure takes place when a tool breaks down and ceases cutting altogether. This can occur as a result of the formation of a crater accompanied by structural failure or by the occurrence of a critically high temperature on the tool flank.

The slope of a tool life line relative to the horizontal direction, *Fig.* 2, is a measure of the relative sensitivity of an operation to temperature and abrasion. A relatively flat slope indicates dominant sensitivity to temperature. A zero slope indicates theoretically that the operation is sensitive to temperature only. A slope of 45 deg indicates sensitivity to abrasion only and the amount of tool wear is proportional to the distance which the tool rubs over the work surface. Most tool life lines have slopes between 0.1 to 0.3.

The lower line in *Fig.* 2 was obtained while cutting dry and the upper one was obtained while using a mixture consisting of 95 percent water and 5 percent sodium nitrite as a coolant. Use of the cutting fluid or coolant permitted operation at near-

ly 40 percent higher cutting speed than could be used for dry cutting. This corresponds to an increase of approximately thirty times in the tool life for the same cutting speed. Such tool life lines can be used to evaluate the influence of all practical variables on total breakdown tool life.

Increases in side rake angle give rise to increased tool life in all cases up to a certain best or optimum value of rake angle. The optimum lies somewhere between 28 and 32 deg for high-speed steel. At rake angles larger than 32 deg, tools begin to chip and spall because of inadequate rigidity. This effect varies considerably with tool material as well as machine rigidity. For example, carbide tools usually have an optimum rake angle ten to twelve degrees smaller than high-speed steel tools.

Differences in workpiece materials can cause tools to behave quite differently as to total breakdown tool life. Stainless steel has a strong tendency to form a built-up edge, plain carbon steel has a moderate tendency, whereas titanium almost never forms a built-up edge. Tool failure when machining steel is most often caused by the formation of a crater; titanium, on the other hand, causes tools to fail by wearing away the flank.

No simple correlation between tool life and strength of work materials exists. Research reveals that tool failure caused by flank abrasion is influenced by several factors in addition to the strength of the material. Relatively little is known about the mechanism of flank wear and the factors which enter into it. Temperature and the strength of the work material seem to be two important factors but there must be others which are yet to be identified and studied.

Substantially the same type of tool behavior occurs in shaping as in turning. This has been shown to be true in varying degrees for a great many machining operations. The principal differences are represented in the slope of the tool life lines and by the incidence of chipping and spalling.

Wear Basis: In practice total tool breakdown is avoided. The cost of tool regrinding and damage

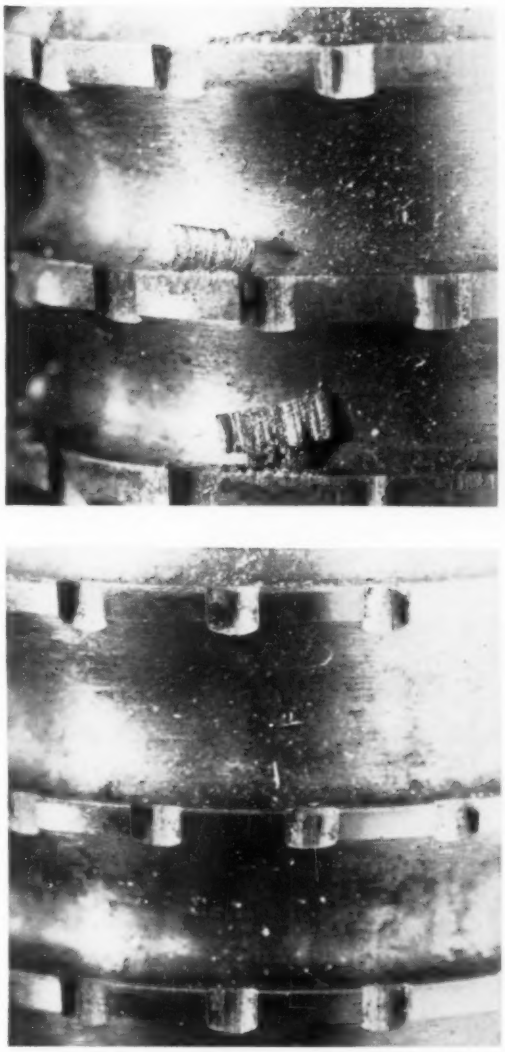


Fig. 5. Photos show condition of roughing teeth of broaches used for tests plotted in *Fig. 4*. Note the greater amount of smearing on the broach lands of tool No. 1 in the upper photo.

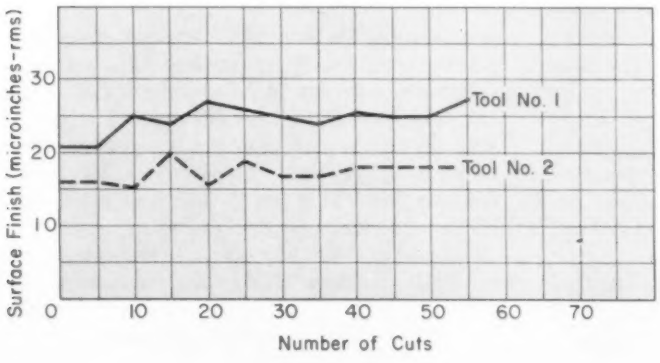


Fig. 4. Increase of surface roughness during internal broaching of holes in titanium. Tool No. 1 represents standard practice with 1-deg relief on roughing teeth and only ½-deg on finishing teeth. Tool No. 2 has 5-deg relief on all teeth.

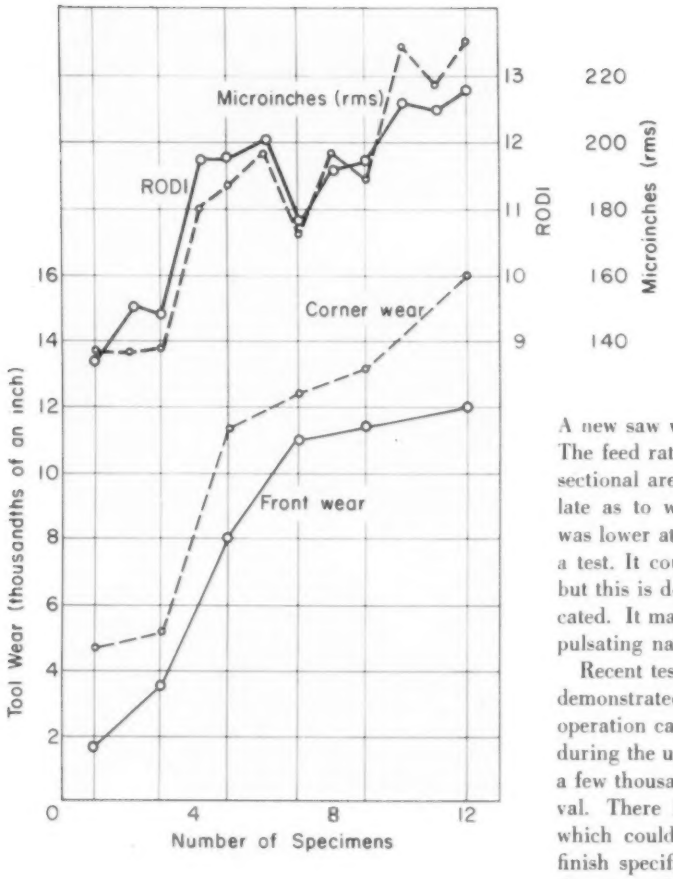


Fig. 6. Tool flank wear and surface roughness for typical form-turning operation on steel. Tool life in this case is determined by limits on surface roughness although the tool would continue to cut easily long after finish has deteriorated.

to the part being machined make running a tool until breakdown uneconomical. There is increasing interest in the rate of wear of cutting tools since it is practical to base tool life on the amount of wear on the tool flank.

In the earlier days of the use of carbides for cutting tools it became quite popular to consider $\frac{1}{32}$-inch flank wear as the upper limit for all operations. This figure was arrived at through laboratory tests for a range of work materials with both turning and milling. The problem is not quite this simple, however, and evidence indicates that the critical temperature may be reached at substantially less flank wear in some instances. This appears to be true in particular with some of the new high-strength, super alloys.

Cutting Force Basis: In sawing operations, either dead weight or constant hydraulic pressure is used for the feeding force. Consequently, tool wear results in a reduction of the rate of cutting. Tool life in this type of situation may be based solely upon the rate of cutting.

The effect of tool dulling on the rate of feeding in a power hacksaw where the hydraulic downfeed is held at constant pressure is shown in Fig. 3. A new saw was used for the beginning of each test. The feed rate fell off almost linearly with the cross-sectional area of the cut. It is interesting to speculate as to why the feed rate in inches per stroke was lower at higher speeds even at the beginning of a test. It could be due to differences between saws but this is doubtful since the behavior can be duplicated. It may be a dynamic effect arising out of the pulsating nature of the cutting forces.

Recent tests on an automatic screw machine have demonstrated that feeding force for a form-turning operation can increase as much as twenty-five times during the useful life of the tool. Flank wear is only a few thousandths of an inch during the same interval. There is some deterioration of surface finish which could dictate an earlier tool change where finish specifications are rigid. On the other hand, the tremendous increase in feeding force can cause a very rapid drift in the size of the part depending on the rigidity of the machine and the part itself. It also has been found that this increase in force can influence the residual stresses induced by the cutting operation. Thus it is possible that in the future change in cutting forces may be used as a basis for determining useful tool life.

Surface Finish Basis: Surface roughness has become a common design specification just like size tolerance. There has been a steadily increasing demand for smoother surfaces in order to produce closer tolerances, reduce friction and increase load carrying capacity. Consequently, tool life is often determined by the length of time a cutting tool will produce a satisfactory surface finish.

Surface roughness of holes broached in titanium with two different tools is compared in *Fig.* 4. Tool No. 1 was made with a one-deg relief angle on the roughing teeth and one-half a deg on the finishing teeth. Tool No. 2 had five-deg relief on all teeth. Surface roughness increased appreciably after broaching only fifty holes and was consistently better with the larger relief angle. *Fig.* 5 shows pictures of the roughing teeth of both broaches. Broach No. 1 with the small relief angle is badly

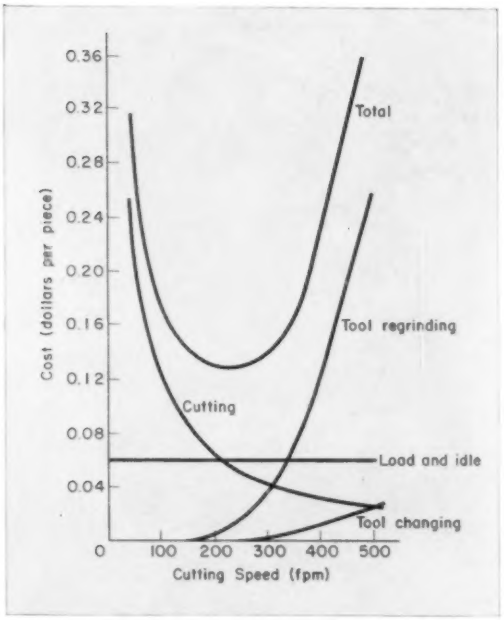


Fig. 7. The best or optimum tool life is a balance of tool regrinding cost with machine-hour cost. Machine idle time and fixture loading time do not affect the optimum tool life.

smeared with titanium. This smearing is responsible for the increased roughness and a substantial increase in the force required to pull the broach through the hole is required. In this case tool life might be determined either by surface finish or by seizure on the land of the broach causing excessive buildup of hydraulic pressure.

A plot of tool flank wear and surface finish as it changes during a form-turning operation on steel is shown in *Fig.* 6. The surface roughness was measured in microinches with familiar equipment and also with a small mechanical device known as a roughness-operated, displacement integrator (RODI). Surface finish deteriorates rapidly after tool flank wear increases beyond 0.004 inch. Consequently, the tool would be worn out at this value if the surface roughness specification had an upper limit of 160 microinches.

Relationship to Practice: It is one problem to determine which of the many different bases for tool life is most significant for a particular job, but it is a quite different problem to develop practices to bring about improvement in each case. Face milling provides a good example of strong dependency upon correct practice.

Tool life can be extended if the workpiece is located below the center of the cutter. At this condition the chip is very thin as a tooth leaves the cut. Consequently the chip, which often welds to the surface of the tooth, is welded over a small area. When a chip welds to the tooth it is subsequently broken or thrown off and may take a small amount of the tool material with it depending upon the area of the weld.

Cutting forces fluctuate over a greater range at low-cutting speeds than at high-cutting speeds with the result that impact fracture may occur more often at low speeds particularly in an interrupted cut such as milling.

It is possible a tool rake angle to be too large, resulting in chipping. Tool materials differ in their sensitivity to this behavior characteristic; consequently, it is often possible to cope with the chipping problem through a change of tool material rather than by decreasing the rake angle.

Tool life has a tendency to increase toward very high values when small rake angles are used. This phenomenon has been attributed to high temperature in the shear zone, which reduces the strength of the material to the point where it cuts more readily. This property has been observed only at relatively high-cutting speeds where there is too little time for a significant amount of heat to flow from the shear zone into the workpiece.

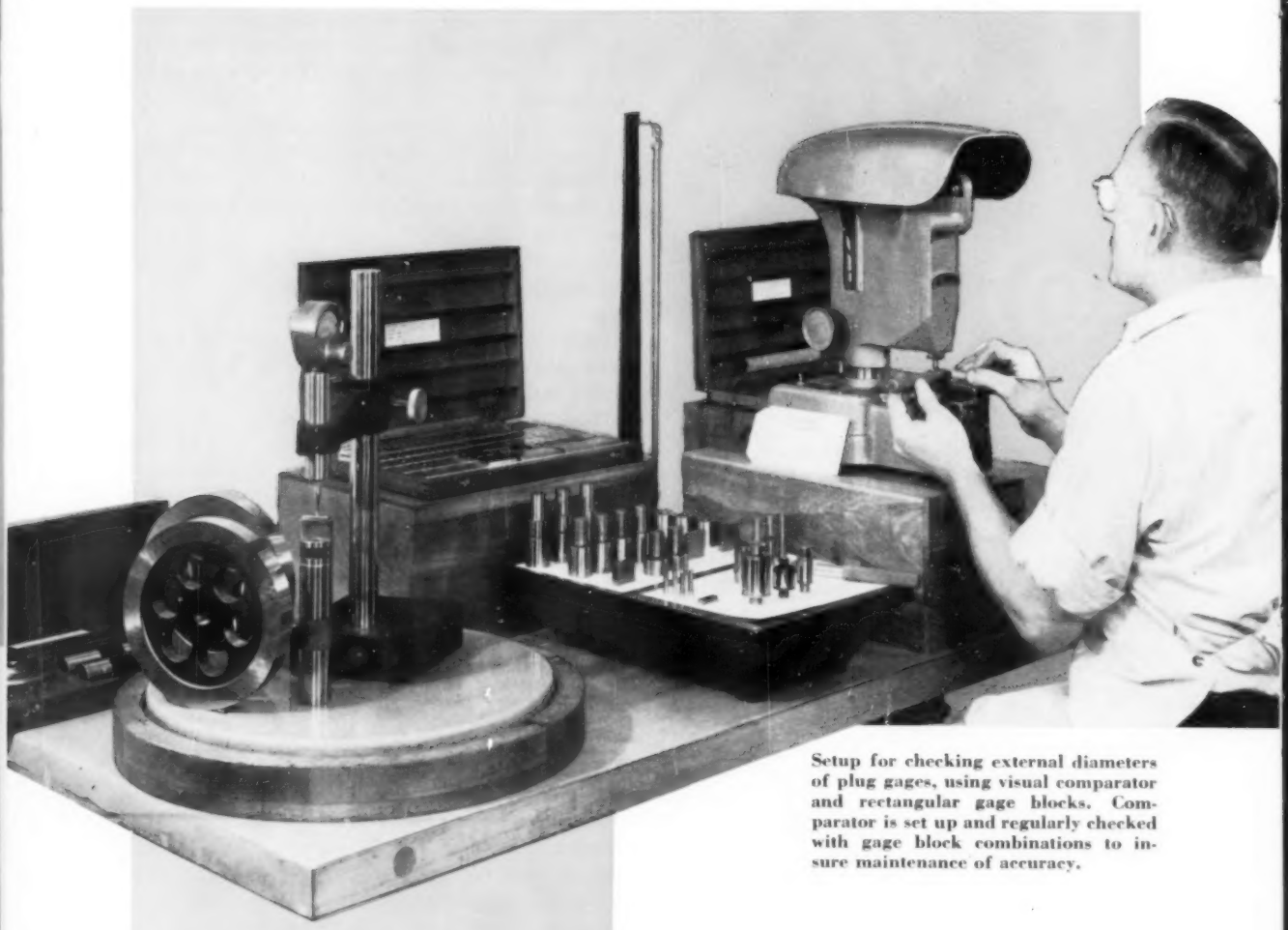
Economic Tool Life: Whatever the basis for determining tool life—total tool breakdown, finish, feeding force or some other factor—there will be a best or optimum tool life for minimum cost providing tool life increases as the cutting speed is reduced. The cost elements involved in most machining operations are shown in *Fig.* 7. The total cost will be high at very low-cutting speeds because of direct labor and machine-hour charges. A similar situation could arise at very high speeds where most of the time is spent in changing tools and the cost of regrinding is prohibitive.

When the cutting-speed-tool life relationship is reasonably close to a straight line on logarithmic coordinates as in *Fig.* 2, the optimum tool life can be determined by the equation:

$$T_o = \frac{1 - n}{n} \left(\frac{C_T}{C_M} \right)$$

Where T_o is optimum tool life in hours, n is the slope of the tool lifeline, C_T is the tool cost in dollars and C_M is the machine-hour cost in dollars per hour. Typical values for n are 0.125 for high-speed steel tools and 0.25 for carbide tools. Hence, for high-speed tools, $T_o = 7(C_R/C_L)$; for carbide tools, $T_o = 3(C_R/C_L)$, where C_R is tool cost per regrind in dollars, and C_L is labor and overhead cost in dollars per hour.

As trends move to ultrahigh speed machining, tool life becomes the most important consideration for ecomnomic operation. A more thorough understanding of the less familiar factors affecting tool life will speed this development and help increase productivity of machine tools.



Setup for checking external diameters of plug gages, using visual comparator and rectangular gage blocks. Comparator is set up and regularly checked with gage block combinations to insure maintenance of accuracy.

a practical basis for SELECTING GAGE BLOCKS

By O. W. Ellstrom
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Criteria for the selection of gage blocks include shape, material, dimensional accuracy and surface finish. Selection of the proper gage blocks for specific applications will result in lowest over-all costs and provide the required size control.

THE TREND toward closer production tolerances has greatly increased the use of gage blocks as a simple, practical means of controlling size and minimizing scrap losses. While modern electronic and light diffraction equipment is suitable for many precision measurement applications, gage blocks are still prime reference standards in industrial laboratories and inspection rooms. Moreover, many manufacturers—faced with the problem of holding tolerances of a few ten-thousandths, or even a few millionths of an inch—have found plant-wide use for

gage blocks as direct measurement standards at production machines.

In view of this trend, the various factors to be considered in selecting gage blocks for specific applications are subjects of considerable importance, in terms of results as well as economy of use.

Rectangular vs Square Blocks: Of these two basic gage block shapes, the original rectangular (USA style) blocks are more versatile and practical for general use on both direct and indirect measurement applications. They are somewhat easier to handle than square (Hoke style) blocks, especially at the machine and, due to the smaller volume of metal, they reach proper gaging temperature faster.

Square blocks are normally used in conjunction with surface plates and other inspection accessories. They are especially useful in checking large dimensions and for internal measurement applications.

Gage Block Materials: Perhaps the most controversial issue in connection with selecting gage blocks is the materials of which blocks are made. Steel, the original gage block material, is still widely used. However, gage blocks made of tungsten carbide, chromium carbide, and chromium plated steel are available. Accordingly, the properties and characteristics of these materials should be evaluated in choosing blocks for a given application.

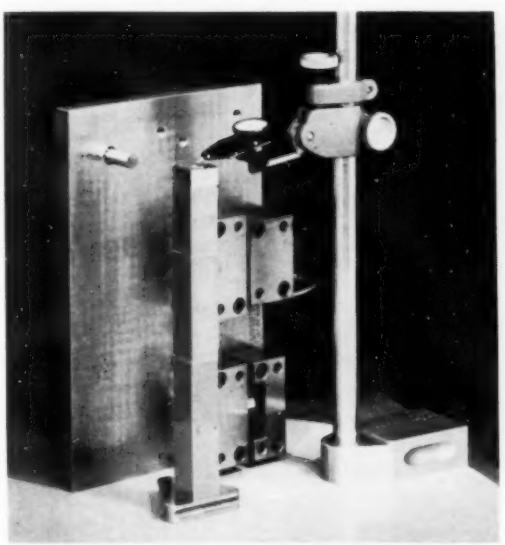
Steel blocks offer the advantage of being easy to "wring" together to build a block combination. Moreover, steel's coefficient of thermal expansion is usually close to that of the material used in parts being checked. Steel has relatively poor wearing qualities and is quite vulnerable to corrosion and oxidation. Consequently, steel gage blocks require more frequent and careful maintenance.

Tungsten carbide, on the other hand, has exceptional wear resistance. Being a brittle material, it is easily nicked and chipped in use. Although its greater weight and tendency to oxidize are negative factors, the major disadvantage of tungsten carbide as a gage block material is its coefficient of thermal expansion. With the exception of very thin blocks, this property makes it an unsatisfactory material for all gage block applications other than those involving inspection of tungsten carbide parts.

Chromium carbide is too recent a development to permit a complete and comprehensive analysis of its value as a gage block material. Its ability to resist wear and abrasion is about equal to that of tungsten carbide. It does not tend to retain burrs the way tungsten carbide does, and has a more sensitive "feel" for gaging work. In addition, it has better resistance to corrosion and oxidation than tungsten carbide or steel. Major disadvantages encountered in use to date have been the tendency to nick rather than wear out, and the problem of obtaining consistent uniformity of quality in the material. On a selected material basis, it has been found to serve well as wear blocks, and as replacement blocks in the more commonly used sizes from 0.050 to 0.150 inch.

Chromium plated steel has the best all-around combination of properties and characteristics to be found in any known gage block material. The superior wear-resistance qualities of chromium over steel are widely recognized, as are its resistance to corrosion and oxidation. Its coefficient of thermal expansion is ideal for a vast majority of applications. Possible "peeling" of the chromium plated gaging surfaces has been described as a major disadvantage. However, in the manufacture of thousands of chromium plated gage blocks, not one has shown any indication of peeling, nor has a single block ever been reported or returned for this defect.

Stability: No matter which of these materials a gage block user may select, however, the stability of that material should be a prime consideration. For, regardless of all other factors involved, if the blocks are not made of a permanently stabilized material, they cannot be relied upon for accurate measurement. For example, except for normal wear is use, a stable one-inch gage block—checked at plus two millionths at standard reference temperature (68 F)—will remain at that size indefinitely. Under the same conditions, a block made of unstabilized material will grow beyond or shrink below original certified measurement dimension due to internal stresses within the material. In properly stabilized blocks, such internal forces are completely arrested. Thus, to be sure of obtaining stable



Square gage blocks are used to check hole locations in a precision gaging fixture during this inspection.

gage blocks, users should always insist upon an unconditional guarantee as to stability from the gage block manufacturer.

Surface Finish: While all gage blocks must have a good surface finish, the degree of fineness is important only insofar as required from a standpoint of actual application. With ordinary steel blocks, for example, the better the finish, the longer the wear life of the block. With chromium plated blocks, a high surface finish is not nearly so important due to the inherently greater wear resistance of the gaging surface material. Regardless of materials, the surface finish of blocks produced by any reputable manufacturer does not vary more than 0.5 microinch, rms.

"Wringability": One of the common misconceptions about gage blocks is that the tighter they wring together, that is, the harder to separate the greater is the accuracy. This is entirely false. The wringability of gage blocks is governed by their flatness, surface finish, and the material involved.

Using a square gage block combination, an inspector sets an internal measuring machine to check the accuracy of production ring gages.

Gage Block Classification by Tolerances

Accuracy Classification	Measured Length (inch)*	Flatness (inch)	Parallelism (inch)
Working (W or B)	+0.000008 −0.000000	0.000004	0.000004
Inspection (I or A)	+0.000004 −0.000000	0.000003	0.000003
(Laboratory (L or AA)	+0.000002 −0.000000	0.000001	0.000001

*Maximum deviation from nominal size per inch of measured length

not by accuracy. Gage blocks which are worn far undersize, for example, will still wring tightly together if flatness and surface finish are within specified tolerances.

Dimensional Accuracy: A basic quality of all gage blocks over which the user can exercise a degree of selective control is dimensional accuracy. While gage blocks are offered in three general classifications of accuracy, and although the specific guaranteed tolerances for each differ among the various manufacturers, an indication of the range of precision that users can expect when purchasing a new set of blocks is shown in the table.

While dimensional accuracy is generally thought of as the most important specification in a manufacturer's guarantee, flatness and parallelism are equally vital qualities. For unless a gage block is flat—and unless its gaging surfaces are parallel, its dimensional accuracy in use will depend upon which point of the gaging surface is used in establishing a desired measurement.

Another important point to consider in selecting gage blocks on the basis of guaranteed accuracy is the matter of the "minus" tolerance specified. A number of years ago, the generally accepted standard tolerance for Working (W or B) Accuracy blocks was plus or minus 0.000008 inch. Recently, steps have been taken by several block manufacturers to reduce or eliminate the "minus" tolerance entirely in order to provide the user with a maximum built-in guaranteed wear factor equivalent at least to the amount of minus tolerance eliminated.

In order to start with true known dimensional accuracy, every new set of gage blocks purchased should be certified by the manufacturer showing the exact deviation from nominal size for every block in the set. And, to maintain their useful accuracy, gage blocks should be inspected, repaired and re-certified as to accuracy regularly, at least every six months, or at more frequent intervals if warranted by use. Such certified inspection services may be obtained from any qualified gage block manufacturer or from the U.S. Bureau of Standards.

Identification: When selecting gage blocks, identification should be given important consideration. Not only should the block set be identified by a registered serial number, the date of purchase and certification, but each individual block in each set should be properly marked showing the nominal size and the serial number of the set to which it belongs. This will eliminate the possibility of mixing blocks from different sets, facilitate ordering individual replacement blocks, and permit maximum utilization. For when properly selected, applied and maintained, gage blocks today represent one of the most practical investments any company can make in protecting its reputation for quality.

High Velocity Machining
with Ceramic Tools

By Wallace B. Kennedy
Chief
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Rodman Laboratory
Watertown Arsenal
Watertown, Mass.

High cutting speeds mean high tool temperatures and shortened tool life for most cutting tool materials. Ceramic tools are not subject to this destroying heat effect and have superior tool life qualities at high velocities.

CERAMIC CUTTING TOOLS have displayed an ability to machine steel at higher than normal speeds, thus offering a solution to the problem of decreasing machining time. Present machine tools, however, are not capable of utilizing these tools to their fullest efficiency. The cutting operation consumes only a small portion of total machining time; consequently, improvements in cutting speeds alone cannot promote major design changes in machine tools. Workpiece handling, tool changing, cooling and chip removal must reach a higher degree of refinement to accelerate these changes.

Tool Life: This is an era of mechanization and automation where every variable of machining must be speeded up to meet today's production demands. Short tool life is the basic obstacle to increased machining speeds and appears to be the only reasonable objection. If machining speeds are increased and tool life can be improved at the same time, then down time required for tool changing is diminished. How then can tool life be increased by increasing cutting speeds? Heat generated at the tool interface is the commonest cause for tool failure. The reasons for elevated temperature at the cutting edge have definitely been established. Means to substantially reduce these metal-cutting temperatures have not. In fact, this has been a target for research for many years. Practical techniques for measuring temperatures at the tool interface have been a constant problem and are currently undergoing a thorough investigation.

Cooling systems do reduce metal-cutting temperatures to some extent, but a satisfactory means of providing lubrication to the tool-chip interface is only one of many problems confronting the engineer today. Enough work has been accomplished in the field to prove that these problems can be approached only from a scientific engineering viewpoint if they are to be resolved at all.

From the time that metal-cutting became a science, investigators have been concerned over the fact that chips were being pushed off the workpiece instead of being cut. One method for diminishing this pushing effect is to increase the side rake to some extreme angle such as 30 degrees which increases the shear angle. Such a side rake causes extremely short tool life. Tool design is based on a combination of cutting tool angles to provide a happy medium for high production rates and economical tool life. The pushing effect still exists and there does not seem to be much that can be done about it.

Rotating Tools: Machining speeds with high-speed steels, are extremely limited since excessive

Abstracted from Paper 68, "New Developments in High Velocity Machining," presented at the 26th ASTE Annual Meeting. Copies of the complete paper can be purchased from Society Headquarters.

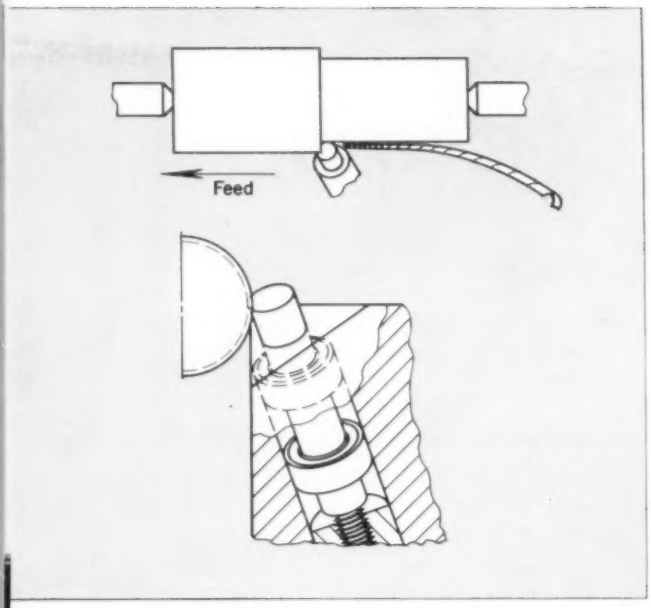


Fig. 1. Rotating tool used for turning. By rotating the tool, overheating of the cutting edge is avoided. The tool proved unsatisfactory because vibration caused chipping of the carbide insert.

speeds cause overtempering of tools, resulting in early failure. When machining with carbides at excessive speeds, disintegration of the binding constituent results. There have been several attempts to overcome overheating, such as the rotating tool shown in *Fig.* 1. A circular tool was mounted in ball bearings and clearance angles obtained by tilting the tool. Since the tool bit itself is rotating as it cuts, heat is constantly dissipated, resulting in longer tool life. Experiments were conducted at Watertown Arsenal with this rotating carbide tool bit. An extremely high radius is presented to the workpiece and when machining long cylindrical workpieces, excessive vibration resulted and caused a considerable amount of chipping on the carbide insert. The chips left the cutting tool nearly perpendicular to the axis of the work in long lengths of tight spirals. The tools remained cool, but attempts to prevent vibration were not successful at cutting speeds of 150 sfm or over. The rotating tool does perform well in light cuts. Following machining passes with the rotating tools, it was observed that only a slight burnishing was evident. Together with a study of the chip, this disclosed a new approach to clean metal cutting. Work is continuing with rotating cutting tools, which offer a possible means of alleviating some of the problems relative to hard-to-machine alloys.

Ceramic Tools: High-velocity machining can be made possible by breaking down resistance of separating the chip form the workpiece. Tool geometry in itself does not necessarily provide the answer since recent advances in machining at high speeds were accomplished only with new cutting tool materials such as ceramics and some newer carbides.

Aluminum oxide tools retain high strength at elevated temperatures. A machining pass 20 to 30 inches long with a 0.100 inch depth of cut at 2000 fpm, using an oxide cutting tool often leaves the tool cool. This has been attributed to the low thermal conductivity of the oxide. This may be true but in such cases, a steel workpiece also remains cool. The tangential and linear feed force paths shown on an oscillograph recorder tape also differ considerably in amplitude from those traced with other cutting tools.

Research conducted at Watertown Arsenal indicated that surface distortion of turned workpieces could be reduced by using high cutting speeds. Following machining passes at a variety of speeds, specimens were cut from two logs at the peripheral areas. The specimens were polished and etched. The specimen at the top in *Fig.* 2 shows the work surface condition following a pass made with a carbide tool at 300 sfm. The white area in the upper half of the picture is nickel plate surrounding the specimen to protect the peripheral surface during polishing. The

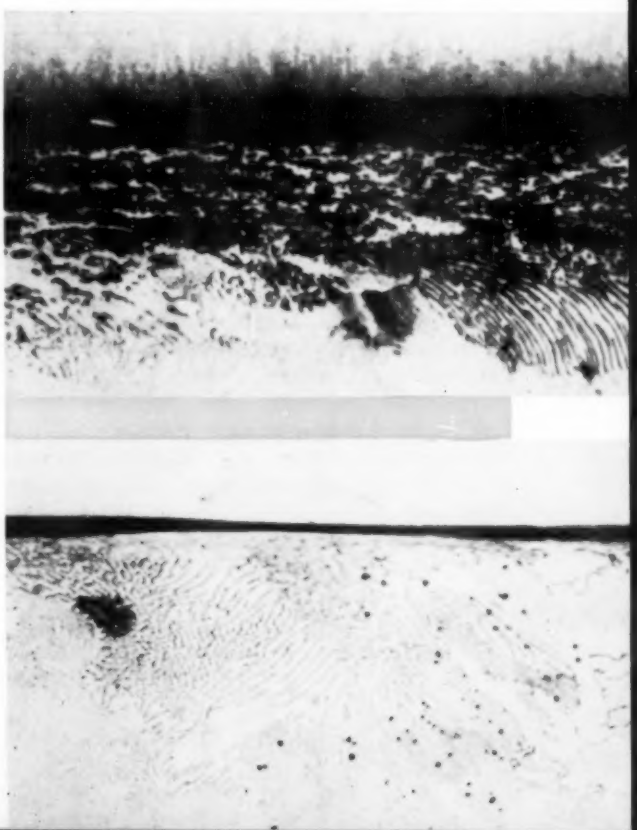


Fig. 2. Surface metal distortion at 300 fpm (upper right) and 1500 fpm (lower right). At higher cutting speeds the metal at the shear point is in a highly plastic state due to elevated temperature, reducing resistance to cutting.

black area is the void between plating and specimen. The distortion of the grains is plainly shown and reaches a depth of approximately 0.0015 inch. The grain distortion results from a pushing or burnishing effect on the workpiece surface.

The second specimen, in the lower photo in *Fig.* 2, was machined with a ceramic tool at 1500 fpm from the same material. With the exception of the ceramic tool and the increased rotational speed all other variables remained equal. The grain distortion penetrates the work surface to an approximate 0.00025 inch. Machining studies have shown that grain deformation is substantially reduced at machining speeds above 900 fpm.

The tensile strength of cast steel drops from 73,000 psi at room temperature to 17,000 psi at 1000 F. Metals rapidly lose strength at elevated temperatures and there is reason to believe that the workpiece surface is in a highly plastic state at the moment of contact with the tool. Consequently, the force required to separate the chip from the workpiece is less. The fact that grain distortion is considerably reduced in the high velocity range (above 1000 fpm) seems to support this theory.

Ceramic tools maintain high strength at high temperatures and the lowered strength of workpiece materials at high cutting speeds tends to promote longer tool life. In addition, friction between sintered oxide and metal under comparable conditions is lower than that between metal and carbides or steels.

Ceramics in Milling: The Rodman Laboratory has explored the use of ceramics in impact machining. Attempts to mill steel with ceramics at speeds in the vicinity of 500 sfm were not successful since a considerable amount of chipping occurred at the corner angle. By increasing rotational speed some encouraging results were produced during the machining of a steel plate of annealed 4140 steel 12 inches long by 2 inches wide by 2 inches thick. The milling cutter body was equipped with one cutter and successfully made three passes across the steel plate at 2300 fpm. The depth of cut was limited to $\frac{1}{16}$ inch with 0.0025 inch chip load. A satisfactory cut could only be accomplished with one of the later ceramics produced for metal cutting. Similar attempts to mill steel two years before with ceramics obtainable at that time were completely unsuccessful because of chipping at the corner angle, and in many cases a complete fracture of the cutting tool.

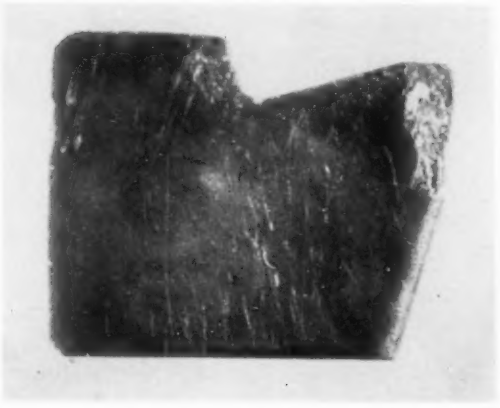


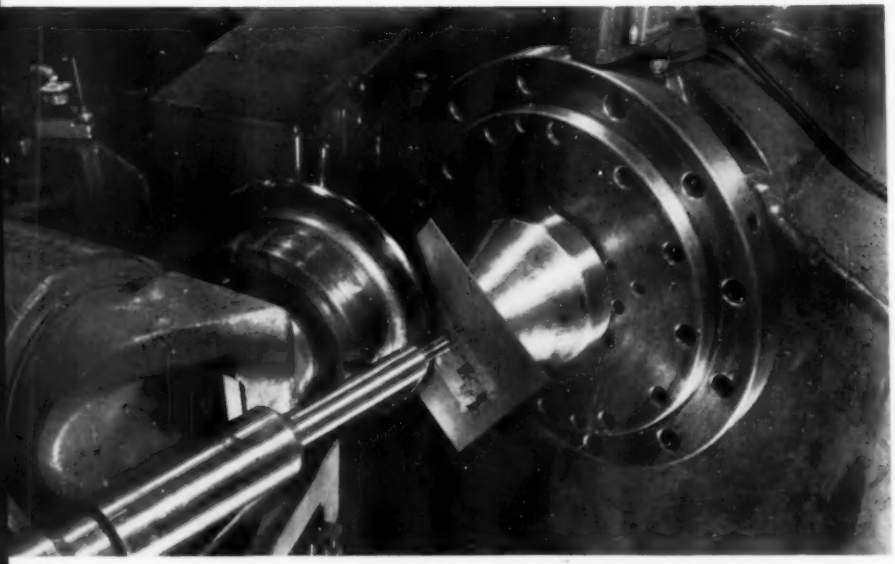
Fig. 3. Ceramic tool used to machine high-temperature, high-strength alloy. The tool fractured after three linear inches of travel at 50 fpm.

It is true that one cutter in a milling cutter body rotating at high speeds results in an unbalanced condition and actually comes under the classification of fly cutting. However, it is common practice in machine shops to employ only one cutter in the holder since more than one blade in a cut can be troublesome when machining thin walled workpieces.

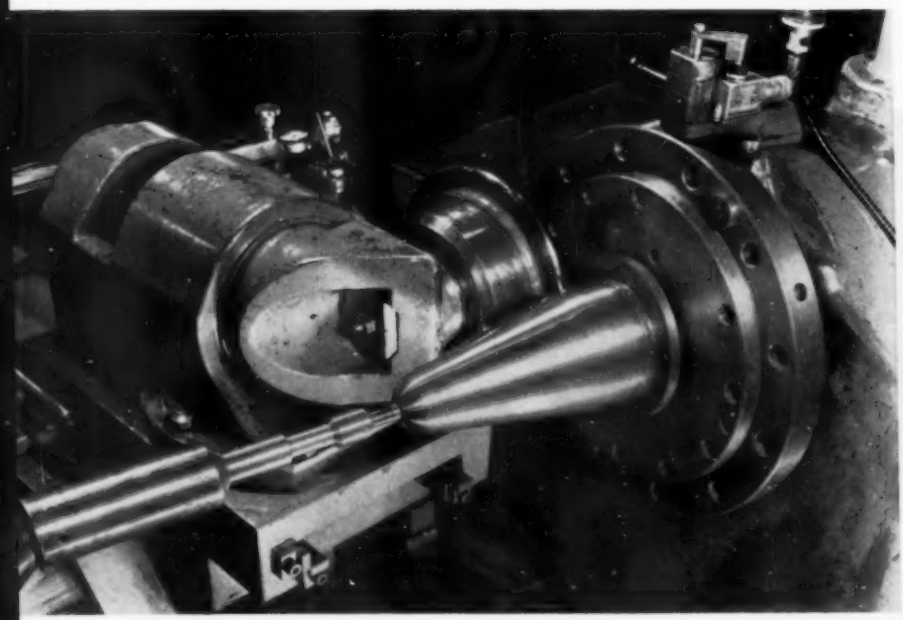
High-Temperature Alloys: Where high-temperature alloys are concerned the ceramic tool, compared with other conventional cutting tools, has proved disappointing with respect to tool life. Attempts to machine Discaloy and Inconel 700 with an oxide tool resulted in poor tool life. Tools with standard nose radii proved unsatisfactory. A tool with $\frac{1}{4}$ inch nose radius and a 15 degree side rake gave best results. The best obtainable tool life would be considered entirely unsatisfactory from a production point of view. The tool used in this experiment appeared worn, but microscopic examination showed that tool failure was actually due to chipping. The depth of cut was 0.10 inch which is, of course, a substantial depth of cut for a high-temperature alloy. The distance traveled, however, was only six linear inches. At 50 fpm a complete fracture occurred at the nose radius after a linear travel of three inches and is shown in *Fig.* 3. Attempts were made to machine both of these alloys with a 45 degree side cutting edge or lead angle. Fracture occurred and showed that thinning the chip with the 45 degree angle did not improve tool life. When these alloys were machined with a C6 carbide cutting tool, the tool life was doubled. At the end of a 13 inch pass, the tool failed. The tool started out by producing a smooth-backed highly compressed chip. At the end of the cut scoring became visible on the smooth section of the chip and rapid failure followed.

Drastic increases in strength of metallic alloys are being demanded by our defense industries. Manufacturing operations have been hampered by a forced decrease in machining speeds when working high-temperature alloys. A challenge has been presented to industry to produce better cutting tool materials and machining methods. Ceramic tools and ultra-high-speed machining seem to offer the best answers to the problems.

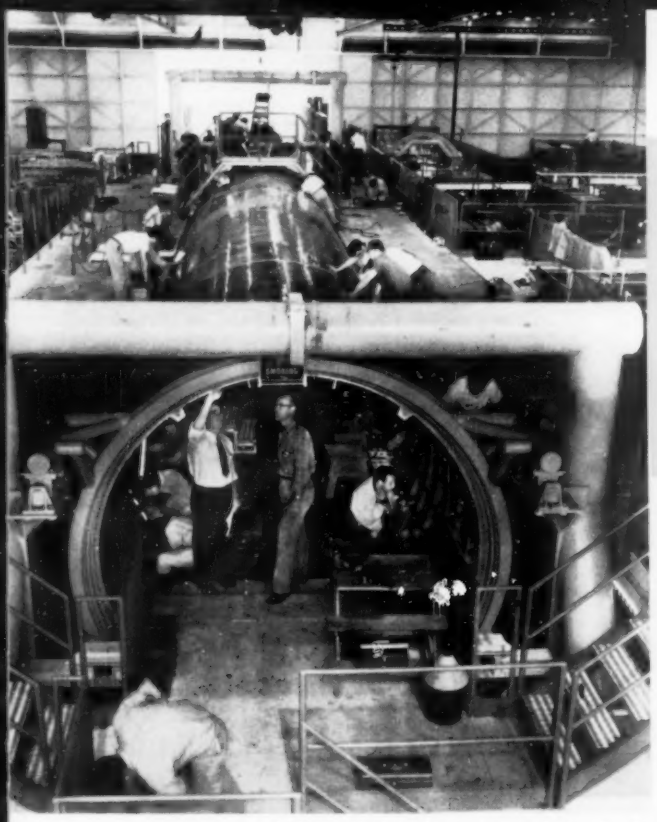
TOOLS at work



HARD materials can be readily formed with modern roll-forming equipment. Stainless-steel blank is transformed into satellite nose cone in Floturning operation at Lodge & Shipley Co.'s Cincinnati plant. Type 430 blank is 0.093 inch thick and weighs 13 ounces. Mandrel has 25-degree taper to form cone.

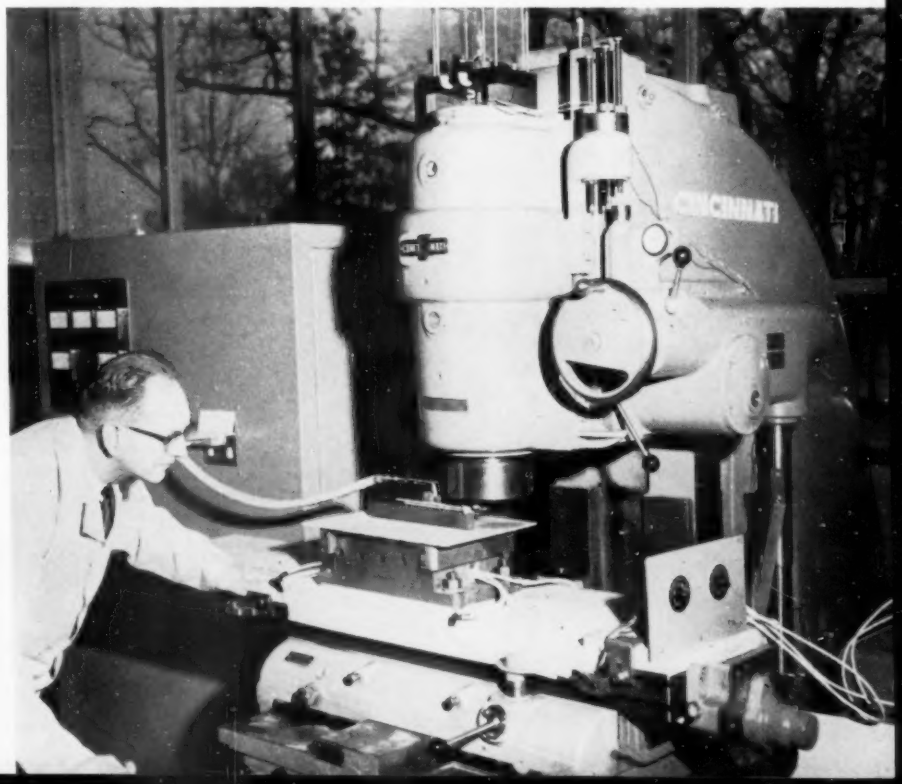


NOSE CONE is elongated during second Floturning operation. Cone shown here is 85 percent completed. Before being placed on mandrel, cone was annealed by heat treatment to relieve stresses. Base is trimmed after the forming operation. Wall thickness of completed cone ranges from 0.013 to 0.017 inch.



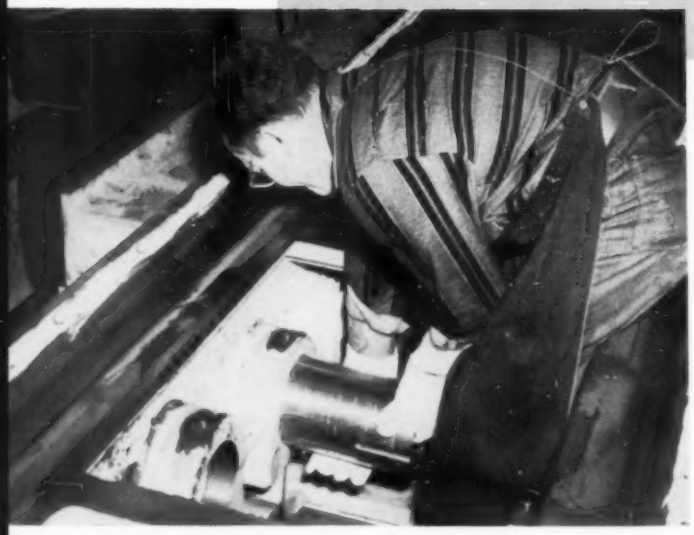
ASSEMBLY of the cylindrical fuselage of the Lockheed Electra transport plane takes place at the company's California Div. Massive tubular dock structure fore and aft insures rigid support for the close-tolerance joining operation. Quarter panels are joined in 94-foot mating dock.

COMPONENTS of inertial guidance system are assembled at Autonetics Div. of North American Aviation. Bright lighting and dust-free atmosphere are essential for this type of work. Requirement for surgical cleanliness is accentuated by the surgeon's smocks and caps worn by assembly workers.

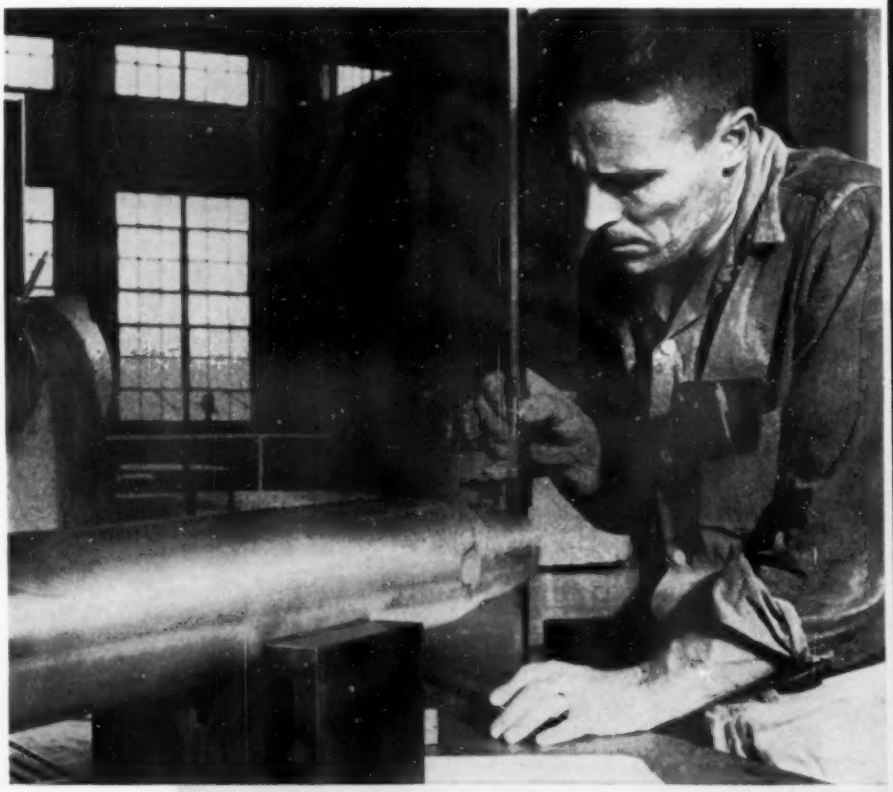


HIGH-STRENGTH thermal-resistant alloys are hot machined in research laboratories of Cincinnati Milling and Grinding Machines, Inc. Workpiece passes through an induction coil located on chuck, then passes under milling cutter. Experimental work has demonstrated that improved tool life results from hot machining.

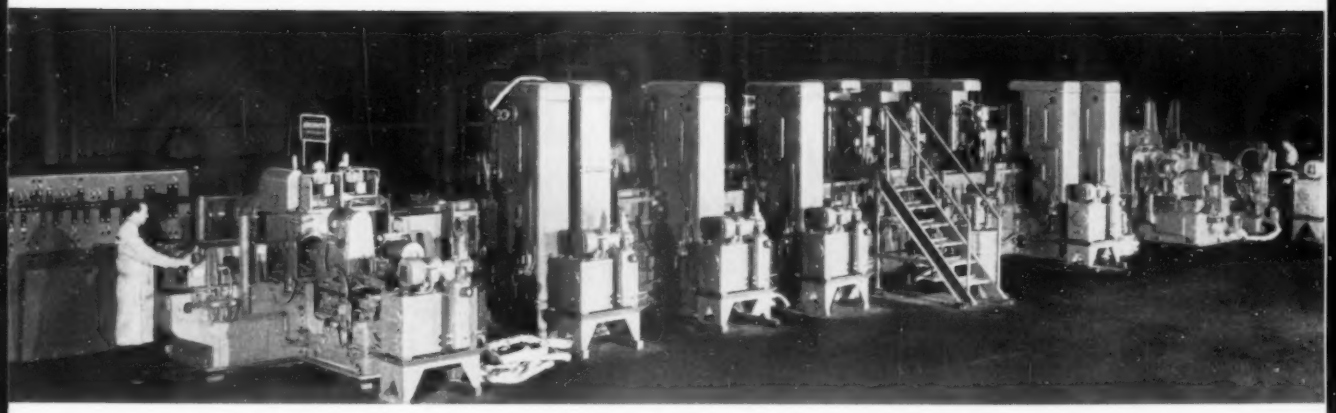
TOOLS at work



LARGE BUSHINGS used as components of machine tools are shrunk in a deep freeze cabinet prior to assembly at Giddings & Lewis Machine Tool Co. Operator wears insulated gloves while inserting the bushings. Bushings expand as they return to room temperature and are thus locked securely without mechanical fastening.

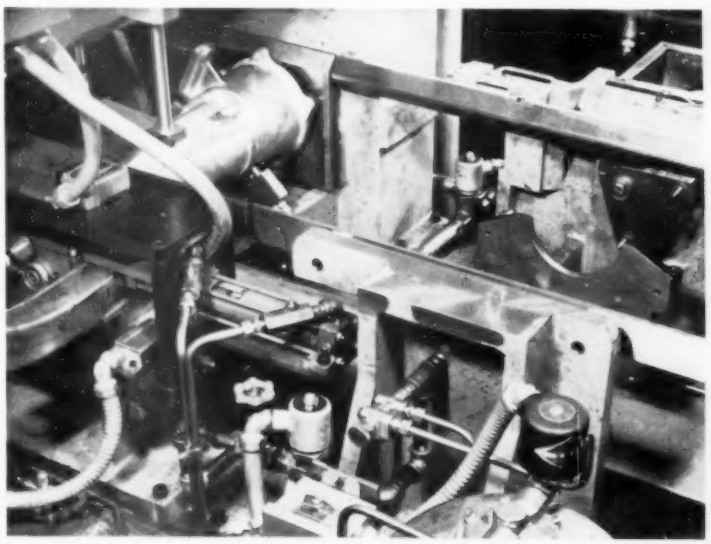


PROBLEMS of missile manufacturer are exemplified by measuring operation performed on a rudder torsion bar. This aluminum bar, which connects the rudders to the steering mechanism of the first stage, must meet exacting tolerances. If measurements vary more than a few thousandths of an inch, the main stage could not be steered with the absolute accuracy necessary to put a satellite in orbit. The housing that holds the rudder drive and torsion bars has 110 critical dimensions. To maintain missile quality standards, Reynolds Metals Co. uses one inspector for every three technicians at its Sheffield, Alabama, missile plant.

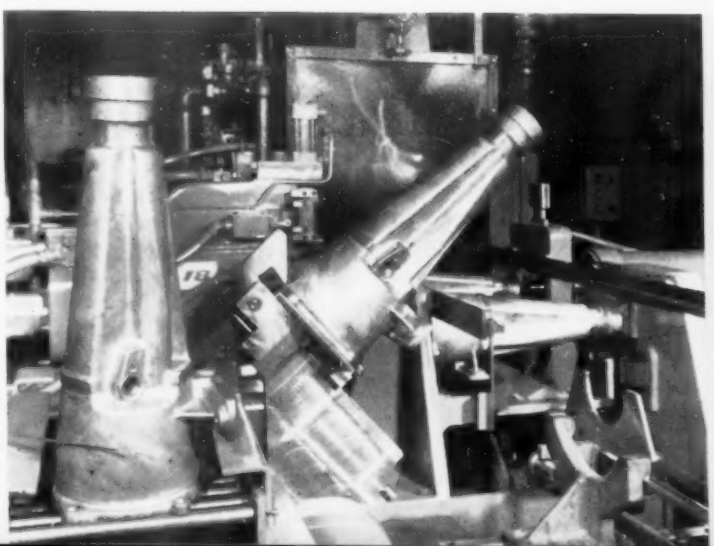


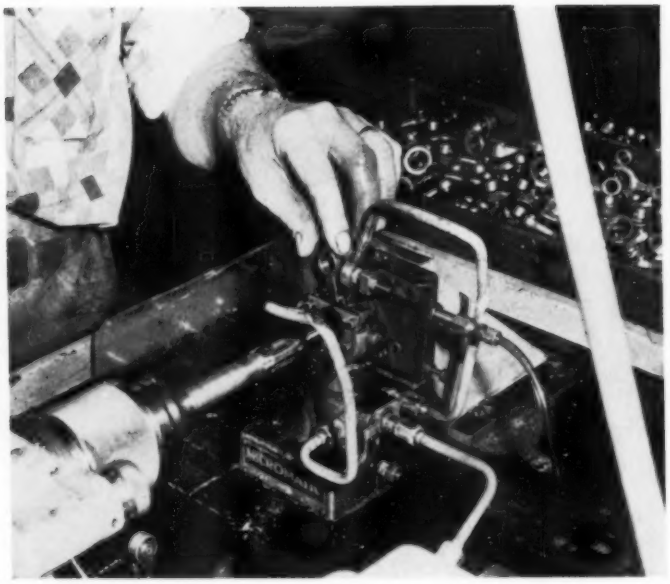
THIS 36-STATION walking-beam in-line transfer machine completely machines 171 aluminum transmission extensions per hour at 100 percent efficiency. The machine includes three workpiece positioners, an automatic unloader, automatic air gaging, a bushing orienter, an assembly station and spin-facing of one end of the workpiece. Building-block construction from standard units provides versatility and minimizes machine design time. Machine was designed and built by Buhr Machine Tool Co.

AT THREE STATIONS in Buhr "building block" machine, the workpiece is revolved around itis longitudinal axis to locate it for subsequent operations. The typical positioner shown here immediately precedes the bushing-insertion station. A revolving arm engages a hole in the flange while the part turns in a V-type nest. Correct orientation is maintained because the arm stays in engagement until the transfer bar approaches the part for pickup. At this time, the arm is retracted and the part is indexed, correctly oriented, to the next station.



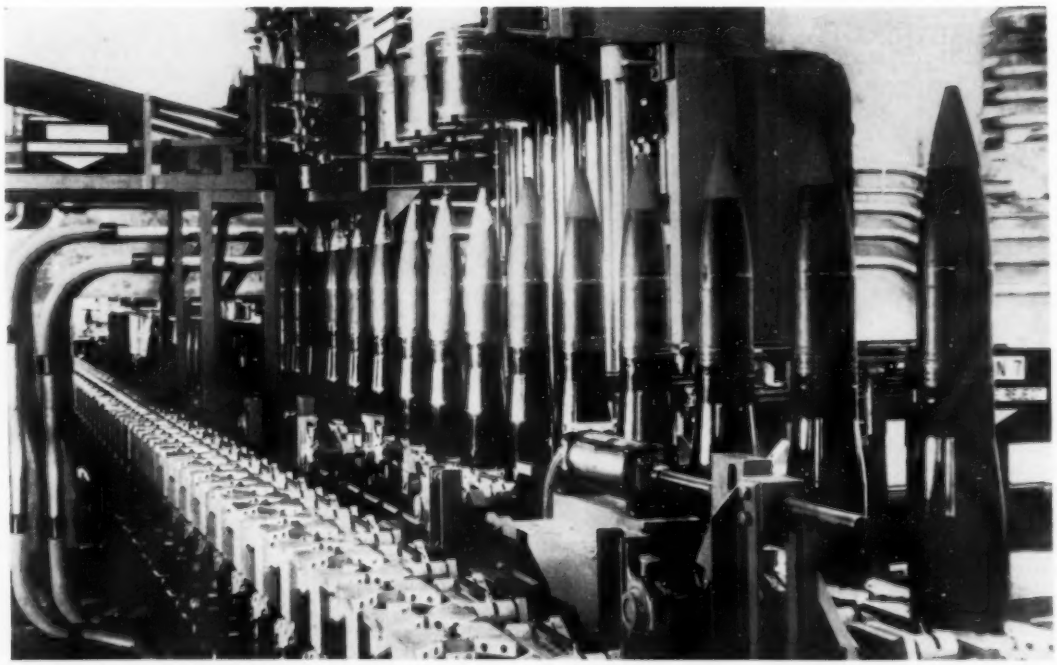
AT STATION 36 of multiple-operation machine built by Buhr, the transmission extension is gripped at the flange end and swung upward and outward away from the cradle on the transfer bar. It is then deposited, large end down, onto a roller conveyor which carries it to subsequent operations.





SIMPLIFIED honing machine built by Micromatic Hone Corp. is used by Tecumseh Products Co. to generate functional surface characteristics on crankpin bores of compressor connecting rods. The bore is honed within tolerances of 0.00015 inch for taper and 0.0002 inch for size and roundness. From 0.0003 to 0.001 inch of stock is removed from the bore, which is 0.875 inch in diameter and 0.43 inch long. Cycle time is 8 seconds and surface finishes are approximately 8 microinches. About 1800 parts are produced per set of honing stones.

TOOLS at work



FULLY AUTOMATED SHELL-FILLING LINE was built by American Machine & Foundry Co. for Joliet Arsenal. The line, which can fill either 75 or 90-mm shells, is divided into 12 stations monitored by a single operator. Five television monitors tie in with cameras focused on critical operations. Shells are positioned in groups of three under weigh hoppers which meter accurately weighed batches of smokeless pellets. At subsequent stations, projectiles are stenciled and crimped into the shell cases and completed shells are gaged. Off-weight or outsize shells are automatically side-tracked from the line. At the last few stations in the line, shells are fed into cylindrical shipping containers.

BROACHING SAVES TIME in small-part production

By James H. Warner, Jr.*
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Because of high tooling costs, broaching is sometimes overlooked when planning production processes. Experience at IBM has shown, however, that higher initial tooling costs may be offset by the greater productivity of broaching.

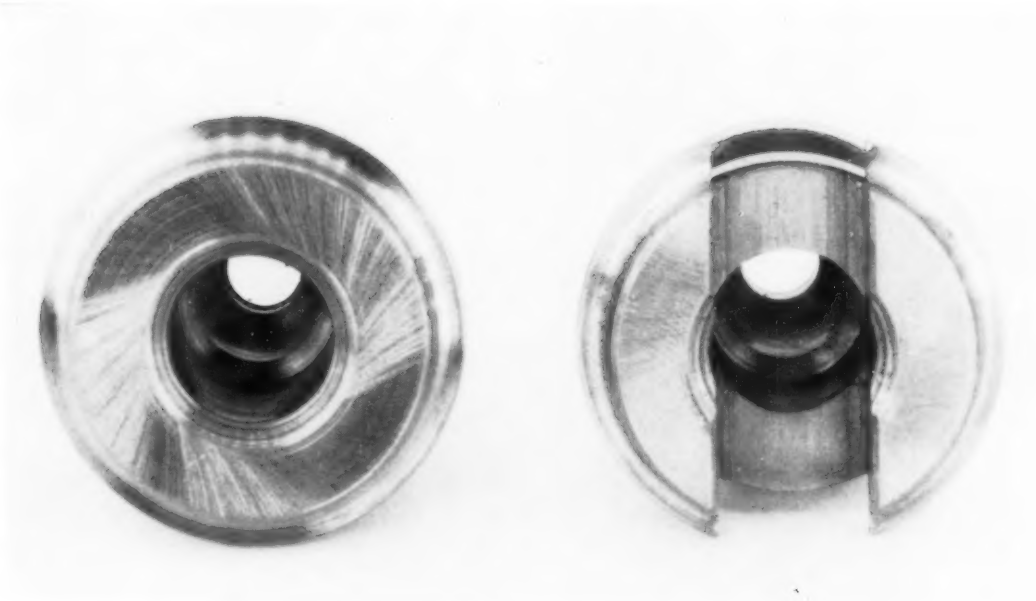
OPERATION SHEETS designate grinding, milling and hobbing when increased output and improved part quality could often be realized by using broaching. The process has many low production applications, especially for fragile parts requiring light surface cuts. Irregular and intricate shapes can be broached to tolerances of ±0.001 inch from a location established on the part. Tolerances of ±0.0005 inch can be held between two or more surfaces cut simultaneously. The bar shown in *Fig.* 1 has a 0.2501-inch slot broached to a tolerance of +0.001, −0.000 inch.

A 30-microinch finish can be consistently obtained when broaching steel with a uniform microstructure and a hardness of 20 to 35 R_C. It is possible to obtain even better finishes and to broach materials as hard as 45 R_C, but broaching costs will be increased.

Softer steels are difficult to broach due to distortion during cutting and the "stringy" microstructure of such materials. The broach often tears the material, leaving a poor finish. If soft or stringy materials must be used, broaches with a special tooth geometry (rake and shear angles of 15 to 30 deg) give satisfactory results. To obtain free chip flow when cutting soft materials, the cutting surfaces of the broach must have good finishes.

When broaching small parts such as business machine components, from 0.010 to 0.032 inch of

*Senior member ASTE Mid-Hudson chapter.



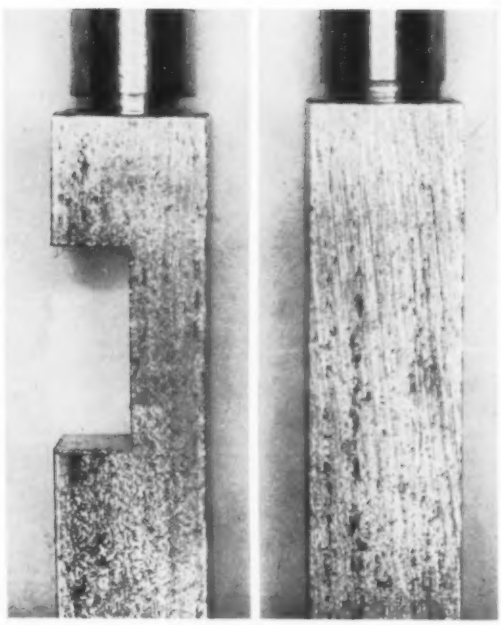


Fig. 1. (left) The time required to broach this business-machine part is twelve seconds, including loading, cutting, unloading and gaging.

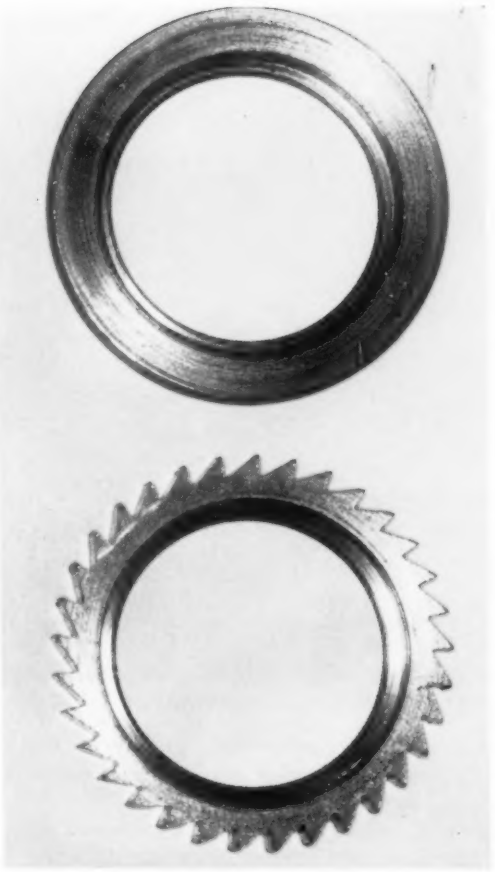
Fig. 2. (above) Increased production from 1250 to 4800 pieces per day was obtained on this part by substituting horizontal broaching for the former rough milling and horizontal broaching operations.

material is removed per pass. Standard small horizontal and vertical broaching machines are well suited for this light work. Generally, these smaller machines are rated at three-ton capacity with a three-foot stroke. An important design feature of the vertical type machines in this range is the retraction of the tool from the cut on the return stroke. This feature prevents the broach teeth from rubbing the part and permits the operator to remove the part from the machine while the ram returns. In the case of the horizontal machines, the tool or the part is removed from the machine before the ram returns.

Strip broaching, a term used to describe both surface and internal broaching, is distinctive because the broach is not removed from the cut on the return stroke. The cost of this type of machine is less than that for a standard vertical or horizontal machine. By comparison with other methods, the disadvantage of rubbing finish teeth over the cut is outweighed by the advantages of close tolerances, good finishes and shorter operation time.

Design of tools for internal broaching requires careful planning because the tool must carry the chips through the entire cut. Fixtures are relatively simple because the part surrounds the cut and supports itself. In the case of surface broaching, the reverse is true. Broach design is simple but the fixture must be capable of supporting the part without allowing distortion under the cutting forces, which are much greater than those developed in grinding or milling. Consequently, surface broaches must be heavy enough to damp vibrations resulting from these forces.

Fig. 3. All teeth on this ratchet are broached in one pass, reducing the process time from seven minutes to 20 seconds per part.



Length of the broach is also an important design consideration. The length determines the cutting cycle and it must be suited to the stroke of the machine on which the tool will be used. By way of example, if the average cut per tooth is 0.001 inch on light cuts for rough and finish teeth, the removal of 0.015 inch requires a blade with 15 teeth. If the pitch is $^3/_8$ inch, the number of teeth times the pitch equals the blade length or, in this case, $5^5/_8$ inch. The length of the broach will change if lighter or heavier feeds per tooth are taken or if the pitch is changed.

Setting up for broaching operations can be simplified if the tool designer foresees difficulties that can prove troublesome to shop personnel. The designer should become familiar with the dimensions necessary for setup. All essential dimensions should be placed on a separate drawing or chart. With this information, setup men can locate fixtures properly and shim broaches to meet dimensional requirements. Subsequent setups will be uniform if the original chart dimensions have been used, no matter how much blade material has been ground off during resharpening. This proper planning by the designer can help eliminate time-consuming "cut and try" practices.

Broaching tools are usually more costly than milling cutters. However, distinct cost-saving advantages will more than offset the higher initial outlay for broaching.

Cost savings can be in the form of reduced machining time. For example, the slot in the end plug, *Fig.* 2, was originally rough milled, four parts at a time, to produce between 600 and 700 pieces per day. Finish broaching of the part, one at a time, on a horizontal machine, produced 1250 pieces per day. The two-operation method was revised when it was learned that both operations could be performed on a chain type horizontal broach at the increased rate of 4800 pieces per day. In another instance, broaching, rather than hobbing, teeth on a ratchet, *Fig.* 3, reduced cutting time from seven minutes to 20 seconds.

Other advantages of broaching include improved tool utilization, better finishes and closer tolerances. Often, broaching is economically favorable because multiple cuts can be made on one broach which would need two or more operations on a miller. These advantages should not be overlooked by any company that is looking for ways to cut costs.

Query Checks Problem-Solving in Smaller Firms

How do small and medium sized manufacturing firms (from 50 to 1500 employees) solve their technical problems? According to a study made for the Office of Technical Services of the U. S. Dept. of Commerce, they depend primarily on in-plant experiments and tests to shed light on problems in equipment, new product development, quality and product maintenance, raw materials and finished components and product improvement. Second source of help is material and equipment suppliers. Large firms provide such services in order to compete for small business customers.

Conscious programs for generating ideas and for solving technical problems are carried on by 65 percent of the 500 firms queried. As might be expected, the newer and more scientifically oriented industries are most active in research; electrical firms, for example, appeared particularly research minded.

Cold Extrusion of Titanium

By A. M. Sabroff
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Air Force-sponsored research has demonstrated that unalloyed titanium can be successfully cold extruded into solid and hollow shapes. Punch and die designs, equipment, lubricants and test results are covered by the authors.

As GREATER NUMBERS of titanium parts are used in aircraft, the need for lower-cost manufacturing methods is increased. Several years ago, the possibility of cold extruding titanium was first investigated. Initial work on the extrusion of solid parts demonstrated that unalloyed titanium could be shaped without machining and that the resultant work hardening strengthened the parts.

This early work was confined to the extrusion of solid shafts and similar parts. While the extrusion of solid parts offers many advantages, many aircraft parts are hollow. Accordingly, research was undertaken to find out whether extrusion of cups and similar shapes was feasible.

Experimental Procedures

Experimental studies were conducted with a 700-ton hydraulic press, *Fig.* 1, comparable to those used in commercial cold extrusion operations. The billet material was AMS 4900 titanium purchased in the form of rolled bar, annealed and centerless-ground to a diameter of 1.480 inches. This billet size was used throughout the studies to simplify tooling requirements. Material properties were:

Ultimate strength, psi	71,800
Yield strength, 0.2 percent offset, psi	54,800
Reduction in area, percent	51.0
Elongation, percent in 1 inch	29.7
Hardness, Bhn	176

The tool assembly was constructed so that experiments could be performed on each of the three types of operation in cold extrusion: forward extrusion of solid bars, forward extrusion of hollow cylinders and backward extrusion.

A schematic drawing of the complete tool assembly for forward extrusion of solid bars is shown in *Fig.* 2. The die and container are press-fitted into tapered double shrink rings with a force of 150 tons. This design permits easy replacement of the container and die and, at the same time, provides adequate support. Sealing force between the container, die, backing plate and die holder is provided by the clamp ring, which is bolted to the die holder.

The ejector is operated by a 100-ton-capacity die cushion located below the bolster plate of the press. While the ejector pin is in its lowered position, a bar six inches in length can be extruded. To minimize the number of parts required for various die sizes, interchangeable bushings are mounted in the backing plate and die holder. Similarly, the ejector assembly is designed so that only the floating ejector pin need conform with a given die size.

By using a die insert, which also serves as an extension of the ejector pin, and replacing the punch as shown in *Fig.* 3, the assembly can be transformed for backward extrusion. In backward extrusion, the punch is, in essence, a fixed piercing mandrel; that

Abstracted from Paper 119, "Design Considerations for Cold Extrusion of Titanium," presented at the 26th ASTE Annual Meeting. Copies of the complete paper can be purchased from Society Headquarters.

Fig. 1. Experimental extrusion of unalloyed titanium is performed on a 700-ton hydraulic press.

is, it is integral with the ram, which functions only as a guide.

The equipment requirements for forward extruding hollow cups are essentially the same as for forward extruding solid bars. The only difference is that a stepped or fixed-mandrel punch is used. For the experimental work on forward extrusion of hollow shapes, the die and container were combined into one unit, *Fig.* 4, because earlier work on solid shapes had revealed that alignment was a problem.

In designing the original tool assembly, the selection of the various components was governed by the load-carrying and wear-resistance requirements. Wherever possible, nondeforming tool steels were used for parts requiring a precision fit in order to maintain close dimensional tolerances during heat treatment. It was discovered that the critical components—container, die and bushings—required greater wear resistance than comparable components for steel extrusion. For forward extrusion of solid shapes, AISI type A2 tool steel (60-62 R_C) was used for the container, D2 tool steel (59-60 R_C) for the die and A6 tool steel (60-63 R_C) for the bushings. For the studies on hollow shapes, T1 tool steel was used for punches and ejector pins and A2 tool steel for dies. These parts were hardened to 60-62 R_C.

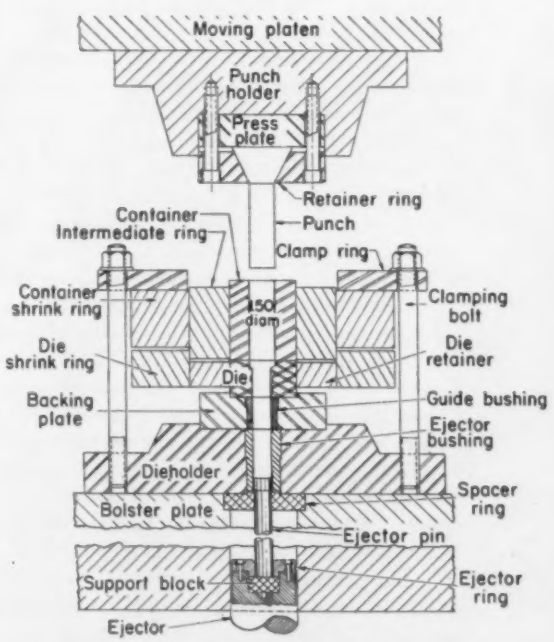


Fig. 2. Punch and die for forward extrusion of solid round bars. Clamp ring is bolted to die holder.

Coatings and Lubricants

In the initial phase of the program, studies of forward extrusion of solid round bars were conducted to seek improved methods of lubrication.

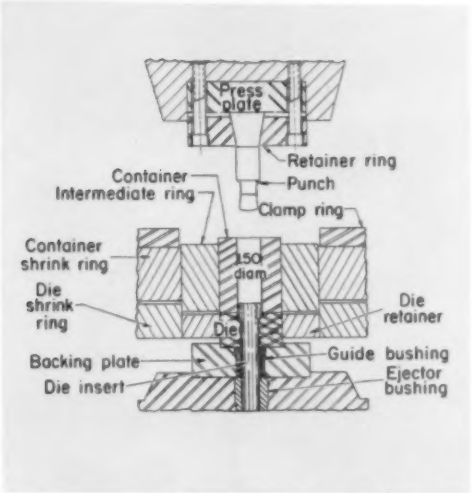


Fig. 3. Punch and die for backward extrusion of cups.

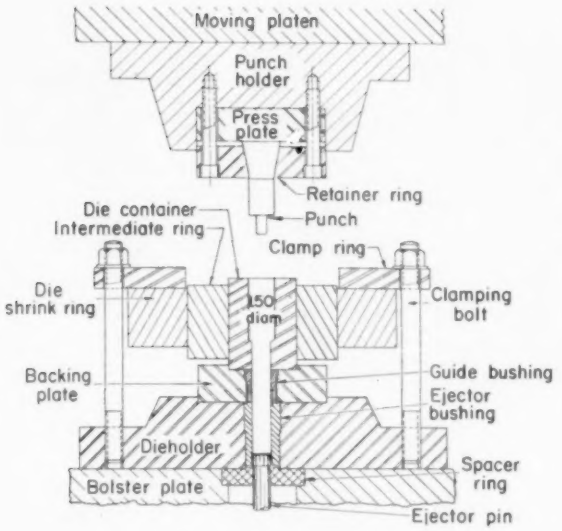


Fig. 4. Punch and die for forward extrusion of cups.

Test conditions, which were held constant throughout the studies were:

Billet size: 1.480 inches in diameter by 2 inches long
Extrusion reduction: 60 percent
Die design: 120 degrees conical
Extruded bar size: 0.95-inch diameter.

During a series of preliminary experiments it was found that the shape of the die entry had a marked effect on the extrusion pressure. Approximately 10 to 15 percent less force was required with a die design embodying a $\frac{1}{16}$-inch bearing radius than with a design having a sharp corner at the die entry, which is favored by many cold extruders of steel. Consequently, the radiused die design was adopted for all of the tests on forward extrusion.

The initial tests were conducted at punch speeds of 6, 20 and 80 ipm. Billets were extruded at each speed using combinations of three experimental coatings and three lubricants. Coatings were fluoride-phosphate, oxidized fluoride-phosphate, and anodic. Lubricants were waxes, soaps, and a mixture of gum resin, graphite and molybdenum disulfide. Extrusion pressure and surface finish were the criteria by which the various conditions were evaluated.

Varying the extrusion speed from 60 to 80 ipm had no significant effect on the extrusion pressure required or on the surface finish attained with the various coating-lubricant combinations. Since a speed of 80 ipm approaches the conditions employed in commercial cold extrusion, this speed was adopted for subsequent studies.

The coatings, in themselves, exhibited no marked differences in performance. Rather, the effectiveness of a given coating in reducing the extrusion pressure and producing a good finish was dependent on the lubricant used. Generally, the gum resin-solid film lubricant produced the best surface finish but required comparatively high pressures. Wax, on the other hand, generally required the lowest pressures but gave the poorest surface finishes. The best surface finishes, 30 to 60 microinches, rms, were obtained with the gum resin-solid film lubricant with the fluoride and oxidized fluoride coatings. Thus, of the coatings studied, the fluoride coatings would be the most desirable for production operations.

A total of 38 lubricants were evaluated. Solid films, waxes and soaps were used both alone and in combination with various carriers. Of the classes of materials tried, only the solid-film lubricants gave surface finishes in the 30-60 microinch range.

Both the amount and type of solid-film lubricant suspended in the gum-resin carrier had a marked effect on extrusion pressure and surface finish. Graphite was the most effective lubricant, followed in order by molybdenum disulfide and boron nitride. At a given total solids content, mixtures containing graphite required lower pressures and generally gave better surfaces than mixtures of molydenum disulfide and boron nitride alone. The best surfaces were produced with mixtures containing a maximum solids content of 10 percent. Mixtures containing

Table 1—Backward-Extruded Parts

Extrusion Reduction (percent)	Inside Diameter (inch)	Wall Thickness (inch)	Cup Depth (inch)
30	0.823	0.338	1.500
40	0.950	0.275	1.688
50	1.060	0.220	1.875

Reduction (percent)	Punch Dimension
	A
30	0.823
40	0.950
50	1.060

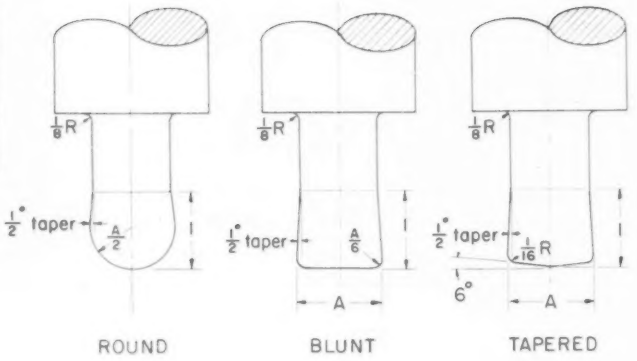


Fig. 5. Three different punch designs used in backward extrusion.

15 and 20 percent graphite required lower pressures but gave slightly rougher surfaces, apparently as a result of lubricant build-up.

The best combinations of extrusion pressure and surface finish were attained with mixtures of 10 percent graphite and 5 percent graphite plus 5 percent molybdenum disulfide in a self-drying gum resin. Extrusion pressures were of the order of 170,000 to 175,000 psi with these materials.

Extrusion of Hollow Shapes

In the studies on backward and forward extrusion of hollow shapes, each type of extrusion was investigated separately, rather than as a consecutive operation in integrated process for making a part. This made it possible to determine the effect of process variables such as extrusion reduction and tool design. On the basis of the lubrication studies, the fluoride-phosphate coating in conjunction with the 10 percent graphite-gum resin lubricant was adopted as the billet lubrication practice. Tests were conducted at punch speeds of 6 and 80 ipm to determine whether extrusion speed had any effect on either extrusion pressure or tool life. In addition, studies on metal flow during extrusion under various conditions were made by using split billets with square grids inscribed on the dividing planes.

Backward Extrusion: The principal variables investigated in backward extrusion were extrusion reduction and punch design. Billets 1.430 inches in diameter by 1½ inches long were extruded with 30, 40 and 50 percent reductions to produce 1.500-inch OD cups. Cup sizes are shown in TABLE 1. Punches with three different tip configurations—round, blunt and tapered—were evaluated for each reduction, *Fig.* 5.

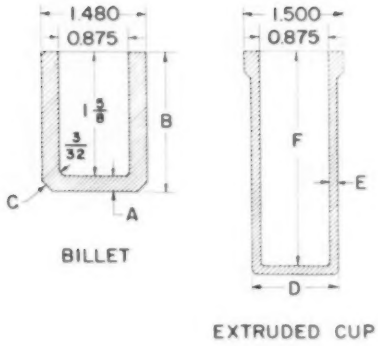
Data for the backward-extrusion experiments are presented in TABLE 2. Originally, it was planned to extrude one split billet and at least three solid billets with each punch at each reduction and speed. Under the extremely high pressures required, however, (up to 394,000 psi) a number of the punches failed before a complete set of experiments could be made. In each case, fracture occurred at the transition between the straight and tapered portions of the punch.

At least one extrusion, either split or solid, was obtained for each punch configuration and reduction at a punch speed of 6 ipm. Extrusions at a speed of 80 ipm were obtained only with the tapered punch at a 40 percent reduction and the round punch at 50 percent reduction. In each case, increasing the speed from 6 to 80 ipm had no significant effect on the maximum extrusion pressure.

Although requiring lower extrusion pressures, the round-tipped punch generally produced poorer inside surface finishes than either the blunt or tapered designs. No galling occurred with blunt and tapered punches and the inside surfaces of the cups were equally smooth.

Forward Extrusion: In forward extrusion of hollow shapes, premachined cup-shaped billets were extruded through 90-deg conical dies with reductions of 20, 30, 40, 50 and 60 percent. The billets were in the form of straight-wall cylinders with flat bottoms chamfered at the edge to mate the die face. Outside diameter of the billets was 1.430 inches; ID was 0.875 inch. Ordinarily, the hollow billet for the forward extrusion of a cylinder would be formed in a preceding backward extrusion operation in which the diameter of the cylinder is established and the bottom portion of the billet is formed to the final outside diameter of the cylinder. Thus, in the forward-extrusion step, the bottom of the billet extends through the die and only the side wall is reduced. Since each of these operations was studied separately, it was not possible to employ this procedure during the tests.

The dimensions of the billets and extruded cups



Extrusion Reduction (percent)	Billet Dimensions (inch) A	B	C	Extruded-Cup Dimensions (inch) D	E	F
20	0.234	1.859	5/32 x 45 deg	1.398	0.262	2
30	0.210	1.835	5/32 x 45 deg	1.346	0.235	2¼
40	0.184	1.809	5/32 x 45 deg	1.289	0.207	2½
50	0.160	1.785	3/16 x 45 deg	1.232	0.178	3
60	0.130	1.755	7/32 x 45 deg	1.168	0.147	3½

Fig. 6. Dimensions of billets and extruded cups for various reductions employed in forward extrusion.

for each reduction are shown in *Fig.* 6. Punch design is shown in *Fig.* 7. This design allowed the mandrel to contact the billet $\frac{1}{16}$ inch ahead of the punch shoulder and prevented the billet from flowing laterally into the die annulus at the start of extrusion.

At least three billets were extruded at each punch speed for each reduction. In addition, one split billet was extruded at each reduction at a punch speed of 6 ipm to study metal flow. Data for the forward extrusion tests are presented in TABLE 3. Increasing the extrusion speed from 6 to 80 ipm generally had a slightly greater effect on the extrusion pressure than in the studies on forward extrusion of solid bars. The increase in pressure with extrusion speed was generally less than 10,000 psi and was not considered a serious drawback.

Smooth surface finishes—60 microinches, rms, or better—were obtained on both the inside and outside of the extruded cups. There was no evidence of galling on either the punch or dies in any of the tests. The typical appearance of the cups forward-extruded at each reduction is shown in *Fig.* 8.

Metal flow during extrusion, as studied by means of the scribed grid lines on the plane surfaces of the split billets, *Fig.* 9, was in close agreement with flow patterns that have been reported for steel extrusions. In backward extrusion, the top surface of the billet flows and expands under the punch to form the inside surface of the extruded cup. As the punch advances against the billet, the layer of metal directly beneath the punch undergoes severe axial compression and flows radially into the annular space between the punch and container. Radial extension and compression are greatest at the billet-punch interface and approach zero at the outer surface of the billet where radial flow is prevented by the container wall. Deformation at the outer surface occurs principally as axial extension.

Elongation of the grid zones is nearly uniform over the extruded cross section, its magnitude being a function of the ratio of cross-sectional areas of

Table 2—Backward-Extrusion Tests

Extrusion Reduction (percent)	Design of Punch	Number of Tests	Extrusion Pressure (psi)	Total Work (in-lb)	Punch Speed (ipm)
30	Round	1	341,000	147,000	6
	Blunt	3	366,000	173,000	6
	Tapered	3	381,000	173,000	6
40	Round	5	338,000	200,000	6
	Blunt	1	368,000	236,000	6
	Tapered	3	383,000	237,000	6
	Tapered	4	383,000	236,000	80
50	Round	4	359,000	249,000	6
	Round	4	364,000	254,000	80
	Blunt	3	374,000	289,000	6
	Tapered	3	394,000	297,000	6

Note: If fewer than four tests are shown, punch failure occurred before the series was completed. Extrusion pressure shown is the average maximum pressure. Total work is also an average.

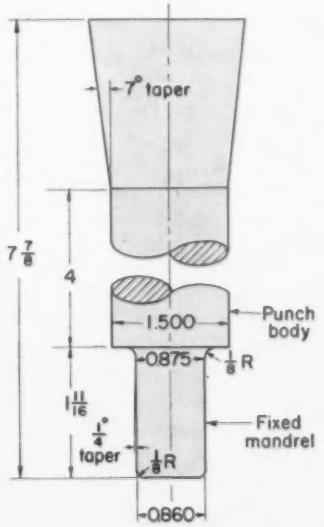


Fig. 7. Punch design for forward extrusion of hollow cups.

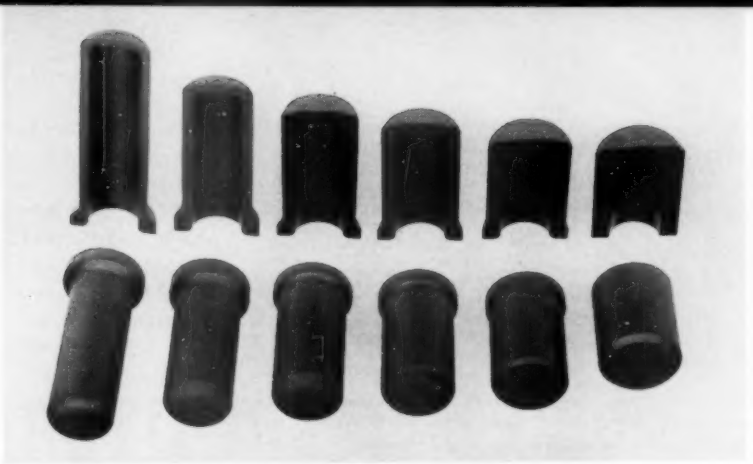


Fig. 8. Typical forward-extruded cups. Billet is at extreme left; from left to right, reductions are 20, 30, 40, 50 and 60 percent.

container to punch (the extrusion ratio). The layers of metal in the inner grid zones, however, are subjected to additional shear deformations which sharply increase in magnitude at the billet-punch interface. Thus, the inner surface is worked more severely than the outer surface during extrusion.

Punch-tip design affects both the depth of metal being deformed under the punch and the path of deformation. With the round punch, deformation is gradual and requires less shear for radial flow. Deformation of the test specimens extends about ¼ inch ahead of the punch tip. The blunt punch offers greater restraint to radial flow from the center of the billet because deformation takes place more abruptly and over a longer path. As a result, the metal at the billet-punch interface undergoes a greater amount of shear. A greater volume of the unextruded billet is deformed with this punch design, extending about ½ inch ahead of the punch tip in the test specimens.

The tapered punch would be expected to be intermediate between the round and blunt designs in facilitating radial flow. With the edge of this punch being sharper than that used for the blunt-tip design, however, the advantage of the taper was not realized. The inner surface underwent greater distortion than with the tapered punch. Grid distortion ahead of the punch was about the same as for the blunt punch.

In forward extrusion of cupped billets, maximum deformation is in the radial direction. During the initial stage of extrusion, the bottom of the billet advances into the die with only a slight amount of deformation, the grid lines being only slightly distorted. As extrusion proceeds, flow becomes markedly nonuniform because of the action of shear stresses on the outer fibers. The amount of shear increases with increasing reduction. Deformation at the inner surfaces occurs principally by axial elongation and radial compression, with practically no shear, even at high reductions. In contrast to backward extrusion, the surface is more severely worked than the inner surface.

Grain and fiber structures of the test specimens corresponded with the metal-flow patterns indicated by the split billets. Grain is coarsest where the least

Table 3—Forward-Extrusion Tests

Extrusion Reduction (percent)	Number of Tests	Extrusion Pressure (psi)	Total Work (in-lb)	Punch Speed (ipm)
20	4	59,000	82,500	6
	4	60,000	88,000	80
30	4	71,000	103,500	6
	6	78,000	107,000	80
40	6	87,500	115,000	6
	4	98,000	122,000	80
50	5	117,500	149,000	6
	3	122,500	151,500	80
60	4	144,500	176,000	6
	4	151,500	181,000	80

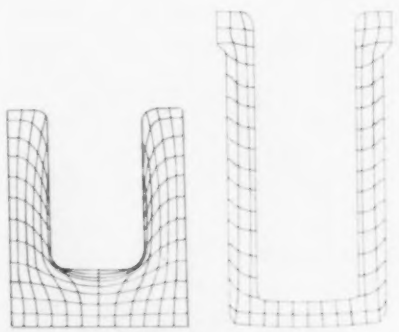


Fig. 9. Grid lines show metal deformation in backward extrusion (left) and forward extrusion (right). Reduction is 30 percent. A blunt-tipped punch was used to form the backward extrusion.

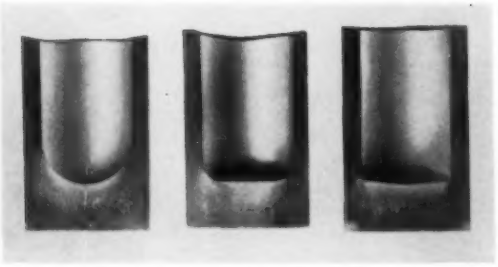


Fig. 10. Backward-extruded parts, showing grain structure. Cups were formed by round, blunt and tapered punches. Reduction is 50 percent.

amount of deformation ocurred and finest in zones of maximum deformation, *Fig.* 10.

Work Hardening

Hardness measurements were made on the longitudinal cross sections of the extruded cups to determine the variations in work hardening occurring as a result of nonuniform deformation of the cross section and varying amounts of cold work at different reductions. Hardnesses were measured on a Vickers tester with a diamond-point indenter at a 10-kg load.

The inside surface of the backward-extruded cups ranges from about 5 to 25 Vhn harder than the outside surface. The spread in hardness decreases with increasing reduction, *Fig.* 11. Hardness along the wall also varies with punch design, over a range of about 15 Vhn, increasing in the following order: round, blunt, tapered. The effect of punch design is most pronounced on the depth of hardening at the bottom of the cups. The hardness ¼ inch from the bottom of the cups is 25 to 35 Vhn greater with the blunt and tapered punches than with the round design. The over-all hardening effect is appreciable, varying from 60 to 75 Vhn over the test range.

Following the pattern of deformation, the hardness across the wall of the forward-extruded cups is greater at the outside than at the inside surface. The spread in hardness decreases from about 20 Vhn for a 20 percent reduction to about 10 Vhn for a 60 percent reduction. Hardness at the outside diameter increases only slightly with increasing reduction, the greatest effect being along the inner portion of the wall. The over-all hardness increase varies between 40 and 65 Vhn, except for the bottom of the cup, which is only slightly deformed and is hardened about 10 to 15 Vhn.

Pressure Requirements

The extent to which the cold extrusion process can ultimately be employed for fabricating titanium parts will be governed largely by the attendant working pressures. This limitation presents itself because the relatively high pressures that may be encountered in cold extrusion, as compared to other metalworking processes, can impose stresses on the tools far beyond the practical limits of design.

Results of the tests showed that forward extrusion of both solid and hollow shapes can readily be performed at working pressures commonly used in metal fabrication. The principles of tool design and construction established for the cold extrusion of steel generally apply to titanium.

Backward extrusion, however, poses difficult tooling problems because of the enormous pressures required. Stresses are beyond the practical limitations of most of the common tool materials, even the ultrahigh-strength, high-speed tool steels used for the punches during the experiments.

It is believed, however, that a more rigorous examination of punch design and construction will both permit extrusion at lower pressures and prolong punch life. When this is achieved, the process should offer an attractive cost saving over methods of fabricating tubular parts.

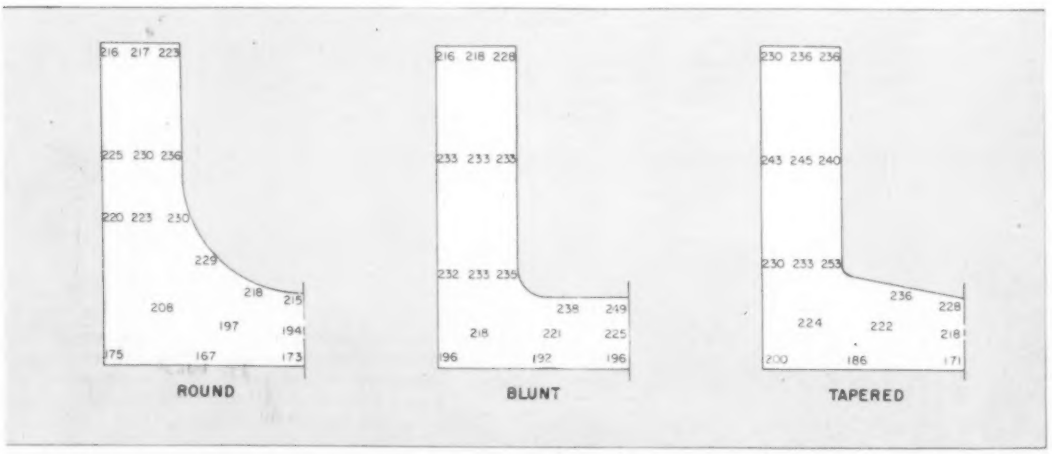


Fig. 11. Hardness of extruded cups varies over the surface. Numerals indicate Vickers hardness number.

Cutting and Grinding Fluids

By E. L. H. Bastian*
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Shell Oil Co.
New York, N. Y.

SELECTION OF cutting or grinding fluids is influenced by initial cost, function, type of results required and available facilities for handling fluids. The types of fluids include water-based solutions, dispersions and emulsions; chemically inactive oils; chemically active oils; and synthetic and gaseous fluids. This discussion is limited to water-base and oil type fluids.

Where cooling is the most important requirement, water-base emulsions or solutions are usually best. If rubbing and friction problems are anticipated, as in low-speed broaching and threading, an oil type fluid is usually preferred because of its anti-welding properties.

Work Materials: The type of work material strongly influences the selection of cutting fluids. High-carbon and hard alloy steels, for instance, are best machined with chemically active oils containing sulfurized fatty oils or equivalent compounds.

For machining tough "stringy" low-carbon steel, straight sulfurized mineral oils are commonly used. These minimize tearing and rough finishes caused by built-up edges on cutting tools. The active sulfur forms a low-shear iron-sulfide film on steel surfaces, facilitating cutting action.

In machining tough ferrous alloys (as in tapping or threading stainless steels), chlorinated or sulfo-chlorinated oils perform well. Chlorine, released actively at relatively low temperatures, appears to act as a "stopgap" between polar type fatty oil compounds and the heavier EP (extreme pressure) films formed by active sulfur compounds at high tool temperatures.

Machining of cast iron is most often performed dry. Sometimes an emulsion is applied as a coolant and to reduce dust. Since cast iron is susceptible to rusting, the emulsion must have good anti-rusting properties.

Most copper and copper alloys, including the ordinary brasses and bronzes, require chemically inactive oils to prevent staining. Either oils or water-base emulsions may be used. Where both steel and brass must be machined with the same cutting fluid, a compromise is necessary.

Aluminum and aluminum alloys are machined with either oils or emulsions. Aluminum can also be machined dry, depending on the machinability of the alloy and the severity of the operation. Where oils are used, light viscosities are preferred to secure good cooling from a rapid, full flow.

Magnesium is machined dry or with light-viscosity inactive oils. Sharp tools help to avoid rubbing and build-up of frictional heat. Mineral oils, mineral-fatty oil blends or inactive sulfurized fatty-mineral oils are frequently used. Aqueous emulsions or other water-based fluids are not recommended for magnesium.

The principal nometallic materials that are machined are the plastics, both thermoplastic and thermosetting types. While lubrication is required, the chief function of the cutting fluid is to cool.

Type of Operation: Cutting fluid selection is influenced by the type of operation, as well as the work material. For vertical surface broaching of mild steels, water-base emulsions or solutions may be used effectively, although oil is usually preferred. Horizontal internal broaching of steel requires a heavier-bodied, more chemically active oil than vertical surface broaching, even when cutting the same material under the same conditions.

Tapping and threading of steel are best done with active mineral-fattty oil blends that give lubricity

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Abstracted from Paper 50, "Cutting Fluids," presented at the 26th ASTE Annual Meeting. Copies of the complete paper are available from Society Headquarters.

and friction reduction at the low cutting speeds used in these operations. Gear cutting, gear shaping and shaving usually require active mineral oil blends to ensure smooth finishes.

Some degree of lubricity is required for drilling, boring and planing to prevent chatter and frictional heat, and to carry away heat generated by chip formation. New types of tools for boring and trepanning operate at extremely high speeds while holding close tolerances and excellent finishes. Cutting oils for these operations are pumped into and around hollow tools under high pressures, forcing the chips away from the cutting edges and flushing them out of the hole. Cutting oils for this type of operation must have good EP properties, must be of low viscosity for ready flow in the system and must have good metal wetting or oiliness properties.

Both light-viscosity additive oils and soluble oil emulsions or solutions are used in milling. The additive oils are employed with HSS tools; the soluble oils with carbides.

Usually, a light-viscosity chemically active oil containing a fatty oil is found best for general automatic screw machine work on steel. Planing and shaping ordinarily require no cutting fluid. In heavy planing, an emulsion brushed on the work surface ahead of the tool provides moderate cooling and facilitates cutting.

Turning and related single-point cutting operations are done with either oil type or emulsion fluids. Sawing operations require soluble oils to clear the saw teeth, prevent chip adhesion, carry away heat and minimize vibration by cushioning cutting action.

Active mineral oils are frequently used for thread grinding. Such oils perform better than emulsions when using fine-grit, dense wheels. Emulsions tend to load up the wheel and prematurely glaze the grinding surfaces. Thread grinding oils are usually higher in viscosity than other cutting oils to minimize the amount of oil thrown off the wheel.

Cylindrical, centerless and surface grinding operations on ordinary ferrous and nonferrous metals are facilitated with emulsion type coolants. An opaque, milky-white emulsion is most commonly used. As coolants, such emulsions are inexpensive, efficient for many grinding jobs and, if properly formulated, cope with difficulties such as water hardness and ordinary contaminants.

Translucent grinding emulsions, prepared from highly compounded grinding oils, are particularly adapted for fine finish grinding. They permit the operator to see the line of contact between the wheel and the work at all times.

Paste type compounds are also used in preparing coolants for grinding. These contain a high-concentration soap and may also contain fatty oils that impart good wetting and lubricating properties. An excess of fatty oils in the emulsion, however, leads to loading of the grinding wheel and formation of deposits in the coolant system. Chip settling may also be slowed by excess fatty content in the fluid.

A general guide to the selection of cutting fluids is contained in the accompanying table.

Recommended Grinding and Cutting Fluids

Type of Operation	Material								
	Low-Carbon Steel	High-Carbon Steel	Stainless Steel	Cast Iron	Nickel, Monel	Copper	Brass, Bronze	Aluminum	Magnesium
Broaching	J	J	J	D10	J	B	C	C	B
Threading	R	J	J	D10	J	B	C	C	B
Gear Cutting	E, K10	F	J	D20	—	—	B	—	—
Drilling, Reaming	E, D10	F, K10	J	D20	E	B	B	B	B
Boring, Turning	D20	K10	K5	—	E	D30	D30	D30	B
Aut. Scr. Machng.	E	E, H	H, J	—	H	A	B	C	B
Milling	D20	D20	K5	D20	F	D30	B	D30	B
Thead Rolling	F	F	F	—	—	A	C	B	A
Sawing	D30	D30	D30	D30	D30	D30	D30	D30	B
Thread Grinding	J	J	J	—	—	—	C	C	C
Other Grinding	D50	D50	D50	D40	D50	D50	D50	D50	B
Honing	J	J	J	—	—	—	—	—	—

Key

A: Mineral Oil
B: Mineral-Fatty Oil
C: Mineral Oil plus Sulfurized Fatty Oil
D: Soluble Oil
E: Sulfurized Mineral Oil
F: Sulfurized Mineral-Fatty Oil (light)
G: Sulfurized Mineral-Fatty Oil (heavy)
H: Sulfo-Chlorinated Mineral Oil
J: Sulfo-Chlorinated Mineral-Fatty Oil
K: Heavy-Duty Soluble Oil

Note: A suffix number after soluble oil designations indicates recommended dilution. Thus D20 is a 1 to 20 oil-water mixture.

aste

The future for Florida's tool engineers looks great to Chairman Stan Petren; Brig. Gen. William L. Rogers, vice commander of Cape Canaveral; and Senator Ted Cabot.

First Chapter in Florida

Blessed with a good round number, Southeast Florida Chapter 150 was chartered May 29 at the Galt Ocean Mile, newest and most posh hotel in the fastest growing city of the fastest growing state.

The Fort Lauderdale launching of the ASTE's latest satellite unit, the first in Florida, filled a vital organizational gap in one of the state's most vital areas of activity—an organization for the men who provide the precision tools used to produce the missiles now nesting at Cape Canaveral.

Chapter Chairman Stanley J. Petren, president of the Florida Tool & Gage Co. at Fort Lauderdale, predicted the chapter would grow from its chartering strength of 131 to more than 200 in a year.

Most of the members come from the missile, electronic, aircraft engine and accessory industries that are burgeoning in the Gold Coast counties of Broward, Dade, and Palm Beach. So it was especially appropriate that the main speaker should be Brig. Gen. William L. Rogers, vice commander of the Missile Test Center at Canaveral (Patrick Air Base.)

Warning that "complacency in our time will surely bring catastrophe tomorrow," the general pledged that the $400 million investment and the 19,000 personnel at the test center were dedicated to doing everything feasible to provide sufficient long-range missile combat capacity—a deterrent capability—for the free world as soon as possible.

"If you," he said, "as leaders of industry and the community, continue to support us and insist on constant military preparedness, the applause of future generations will be one of the values received on our investment."

General Rogers reminded the tool engineers and their guests that missiles, regardless of how well they have performed under test conditions, are useless to the defense of the country until military crews are capable of assembling, maintaining, and launching them. To this end, he declared, "we have military personnel at the Cape right now training on the Air Force's Thor, Snark, Bomarc, and the Army's Redstone."

The general reassured the Floridians that neither the $6 million monthly payroll at Patrick, nor the many millions invested in supporting industries, are in jeopardy.

"I understand that since the establishment of the Pacific Missile Range, rumors have occasionally developed concerning the permanency of our operations here in Florida. . . . There is nothing in the future of Patrick but growth and expansion. It will not in any way compete with the Pacific range, which is being established primarily to train crews on missiles already out of the development stage."

ASTE Vice President H. Dale Long was chartering officer, assisted by Staff Administrator Marvin J. Bunting. Herbert D. Hall, past chairman of the national program committee, was toastmaster.

Among the ASTE's guests were Fort Lauderdale City Commissioner Edward H. Johns; State Senator Ted Cabot; Ted David, speaker of the House from 1949 to 1956; Arthur W. Saarinen, president of the Fort Lauderdale Chamber of Commerce; and Mayor Horace S. Miller of West Palm Beach.

Vice President H. Dale Long swears in officers of Southeast Florida Chapter 150: Stanley J. Petren, chairman; Thomas L. Williams, first vice chairman; C. James Brindell, second vice chairman; Paul N. Krebs, treasurer; and Joseph P. Bowles, secretary.

Land of the Count-Down Count-Down comes of age

by M. L. Stone

FLORIDA—land of sunshine and of the count-down, land of mermaids and missiles, land of milk and honey and bilk and money—has taken another confident step toward industrial maturity with the formation of the first chapter of the ASTE.

Former Speaker of the House Ted David, who's being talked up as gubernatorial material and who's a master of understatement in a climate of overstatement, said at the chartering in Fort Lauderdale: "When tool engineers arrive in Florida, industry cannot be far behind."

Industry's already there, of course. The 131 members of Chapter 150 aren't tourists. Organization of the new Society unit, in fact, gives overdue national recognition to the industrial competence and manufacturing knowledge of the area.

Gwilym A. Price, president of Westinghouse, recently characterized the new Florida hurricane: "Highly technical industries are plunging the South, and most dramatically, Florida, into an advanced state of technology. That is the deeper significance of your industrialization here—so much of it is new industry based on research—chemical, nocleonics, electronics . . . ."

The missiles and related industries, especially electronics, are expanding just about as fast as buildings can be constructed and engineers and technicians hired. The list of concerns engaged in missile and related contracts and subcontracts in the state reads like a Blue Book of America's great aviation and communications industries: Martin, Convair, Northrop, Douglas, Boeing, Lockheed, Westinghouse, Sperry-Rand, General Electric, RCA, Minneapolis-Honeywell.

Only two days before the chartering of Southeast Florida chapter, Pratt & Whitney dedicated a 750,000-square-foot, multimillion dollar research plant in Palm Beach County.

But despite the spectacular nature of the missile program and the large direct and indirect contribution it is making to the state's economy, the real bread-and-butter of Florida's industrial prosperity comes from the great diversity of plants which produce goods for civilian rather than military use.

Of the 21 major manufacturing industry classifications recognized by the Federal Government, Florida obtained representative plants in 20 of them during the past two years. The state already was well represented in the 21st, tobacco products. Floridians don't let you forget this diversification—they feel it is important in protecting their economy in periods of recession, and that it is insurance against the type of circus-tent collapse that knocked the state down for the count in 1926.

Because of this unpleasant memory, "boom" is a dirty word in Florida. It connotes "or bust." Nevertheless, there's been a noteworthy revival of a decidedly heady feeling across the state, and it's not confined to real estate or tourism this time.

LOOK at these random facts:

- In 1950, Florida was 20th in population (2,771,305) among the states; in 1957, 13th (4,750,000); in 10 more years, the guess is 8th (7,000,000 plus).
- Broward County, home of ASTE chapter, increased 144.5 percent in population from 1950-56.
- In 1956, 441 new plants were established in the state; in 1957, more than 700. Broward-Dade-Palm Beach area lured 225 new plants in 1956, with 7608 employees; 350 new plants in 1957.
- Florida led the entire country in manufacturing employment increase during 1957, both numerically and percentagewise, with only five states showing increases and 40 showing losses. U. S. Average, 4.9 percent decline; Florida, up 5.5.
- Electronics manufacturing industry alone has tripled in three years to 100 firms, 10,000 employment, annual payroll topping $40,000,000.
- Atomic Energy Commission's current budget in Florida is $16,214,000, of which $12,000,000 goes to operation of one electronics factory.
- Annual payroll of just four companies in

Count-Down Count-Down

electronics-engineering fields, established in Fort Lauderdale in past two years, is better than $2,250,000.

- Three years ago there were six machine tool shops in the Lauderdale area; now there are 30 in the phone book.
- Florida Power & Light will spend $450,000,000 in next five years on expansion.
- Eight of the larger electronic manufacturing plants employ a total of 7200 people—and all except one have begun Florida operations since 1955.
- Florida has appropriated $5,165,000 for nuclear research at state universities; has established a Nuclear Development Commission and retained a top-notch research firm to advise it on how to keep atop the atomic world.
- Besides Cape Canaveral, Florida has 16 major military installations, including Eglin Air Force Base on the opposite coast where 15,000 people are engaged in missile testing and other defense work.
- There are new, major overhaul facilities for existing jets, including DC-8's, the upcoming offering of major airlines.

NOW. What's the truth about all this? So many plants came in, sure, but how many went out? How many people are unemployed? Is the country overbuilt, oversold, overextended? Is the peninsula a horn of plenty, or is it in a dilemma as a result of blowing its own horn?

For some strange reason, none of the elaborate brochures put out by the hornblowers contain answers to such questions. One gets the feeling that the press releases are highly eclectic. Now and then an unreconstructed Yankee will rebel against the ballyhoo boys. One of them, the vice president and general manager of a large, new machine tool distributing firm launched last fall by an entente of Northern companies, blurted out his own agonizing appraisal:

"Do you want to know the truth? Of course we're overbuilt. We've got growing pains, plenty of them. There's a big labor surplus which we can't cope with. And they're not all octogenarians, either; too many of them are young marrieds who come down here with $400, a station wagon full of mortgaged kids, a high standard of living to maintain, and no jobs to find. Some of them go into business, and some of them go back north, broke. We've got a long way to go to catch up with our population down here."

But it remains that industry *is* growing like the subtropical flora, for six good reasons: a market; a labor supply lured by the fringe benefits of living in Florida; high productivity (a survey of the New York and Miami plants of an electronics firm showed output per manhour was 15 percent higher in Miami); an abundant supply of water; industries' trend to decentralize; proximity to Latin American market; and last but not least, a favorable state tax climate.

The U. S. average of state taxes that affect business and industry totals 23 percent of total revenue, where the comparable figure for Florida is under 12 percent. State tax on outstanding capital stock is relatively liberal: a firm capitalized at $100,000 would pay $500 in Massachusettes, $75 in Florida; a $5,000,000 firm would pay $5,000 in Ohio, $25,000 in Pennsylvania, $1000 ceiling rate in Florida. The 3 percent sales tax also carries a $1000 ceiling when applied to heavy machinery. Florida has no personal or corporate income tax.

HOW does the new ASTE chapter fit into the future?

"Among our 131 members," said Thomas L. Williams, Reynolds Aluminum sales engineer who is the chapter's first vice chairman, "we figure there are 2000 years of tooling experience. We intend to see that that is made available to anyone who needs it."

Chairman Stan Petren, president of the Florida Tool & Gage Co., thinks the new unit can do much to assist existing businesses in solving their technical problems. "In addition, new manufacturers will be attracted to the area by the knowledge that there is an ASTE chapter here—thus indicating a labor pool of highly skilled personnel."

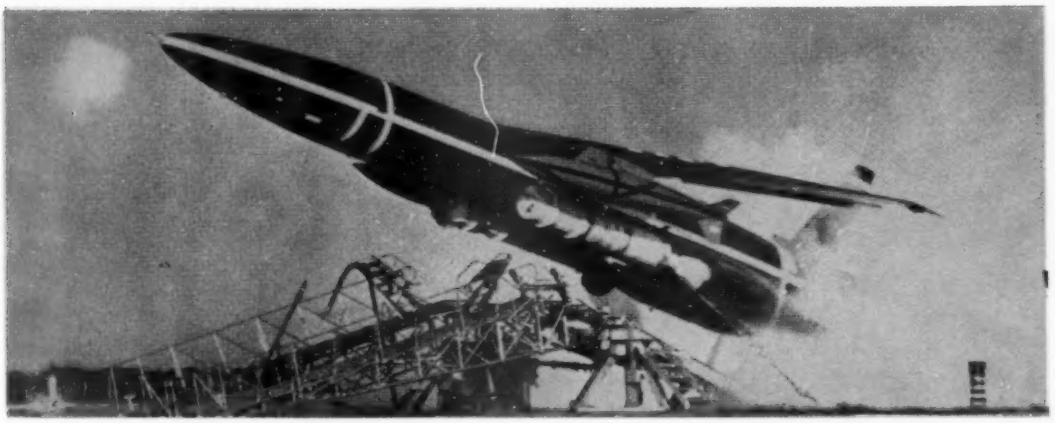
He sees the key role of the organization as lying in the area of subcontract solicitation.

"Many big firms in Florida have big government contracts adding up to hundreds of millions. The great portion of these contracts are subcontracted, and it is to our interest to see that the abilities of Florida manufacturers are made available to the prime contractors.

"We plan to get lists of all southeastern Florida manufacturers—their machinery, the type of work they do, how big they are—and make the information available to the big firms. We want the prime contractors to know who in Florida—whether an ASTE member or not—can do this, that or the other thing.

"This chapter should go a long way toward further industrialization of the Gold Coast—the kind of 'clean,' highly technical industrialization that people want down here."

California beckons in the Fall of '58



Symbolic of California's pioneering — first in conventional plane manufacture, and recently in space-age vehicles — this intercontinental Northrop Snark SM-62 is an example of West Coast "know-how" in missile construction — and of one of the major reasons for its increasing need for new tools, equipment, and factories, and for men skilled in tool engineering to plan and man them.

Space Age theme keys Western Show

While Florida blooms and booms, California is, of course, not standing still in the areas of industrial expansion, ASTE activity, and tourism. All three facets of the sprawling metropolitan Los Angeles area will be on exhibit this fall when the Society's Western tool show checks into the spacious Shrine Exposition Hall Sept. 29 for its five-day run.

Theme of the show is "Tooling for the Space Age," an apt one, considering much of the recent industrialization on the West Coast has been in the missile, rocket, aviation, electronic, and related fields. Whereas Florida's claim to fame has been mainly in the research and testing of space-age vehicles, California, long known as the cradle of the aviation industry, has led the country in the developing and building of missiles, jets and rockets. The fabrication techniques so peculiar to conventional aircraft have been extended and perfected for use in the highly critical construction of the supersonic jets and space-pacing missiles of tomorrow that are, surprisingly, here today.

California's explosive growth in population is also both the cause and result of an equally spectacular increase in the demand for products of *all* kinds, a frantic industrial expansion to produce these products, and an influx of product and process designers, tooling technicians, and manufacturing "Magi"—the very stuff from which ASTE units are formed.

The fact is, ASTE in California is nineteen years, twelve chapters, and some 3600 members ahead of its traditional rival, Florida—its members represent about a tenth of all Society members everywhere. With this vanguard of tool engineers (Los Angeles County boasts the highest concentration of engineers to be found anywhere in the world) and such a show of industrial vigor (in the past decade, manufacturing employment has doubled, and more than 5000 new plants have mushroomed in the area), the fall tool show and the accompanying convention hold great promise for both local and visiting tool buyers and suppliers. Seventy-five percent of the space in the tri-level Shrine hall has already been sold out, Tool Show Manager Leonard Abrams reports.

Convention Manager Dick Bacik promises a full complement of convention attractions, from technical sessions and plant tours, on the educational agenda, to feminine forays on Farmers' Market and excursions to the Arboretum, Marineland, Disneyland, and movieland. The semiannual directors' meeting will take place on October 1 and 2. A California Day luncheon, boasting welcomes by city and state dignitaries, will usher the event into the "City of the Angels," a forum type meeting will explain ASTE and the profession of tool engineering to local vocational guidance counselors, and a closing banquet will climax the week's activities.

First Canadian

Attentive Canadians—and one Texan, H. E. (Rip) Collins, front center—listen to a technical paper during conference at McMaster University, Hamilton, Ont.

W. A. (Art) Thomas, head of engineering management, Ford Motor Co. of Canada, and national director, ASTE, speaks on the problems of management.

Canadian industry's inherent attributes of a small-plant plurality and short-run production supplied the background theme for the first Canadian on-campus conference April 19. The setting was the beauteous and burgeoning campus of McMaster University, situated on the west side of Hamilton, Ont.

Representing eight of the nine Canada chapters of the ASTE, 170 registrants heard four papers and, at the luncheon, a talk by then Society President H E. Collins on "ASTE Looking Into the Future."

W. A. (Art) Thomas, ASTE national director and superintendent of engineering management of Ford Motor Co. of Canada, Ltd., at Windsor, gave some impressive statistics on the state of Canadian manufacturing—4,500 plants with an 800,000-member work force, turning out better than $22 billion worth of end products annually—in his talk on "Manufacturing Management," the first paper of the day.

Mr. Thomas stressed the importance of smaller plants in Canada. He noted the interdependence of

both small and large industry in a country where a third of the so-called small firms are contract suppliers to big companies, both domestic and foreign.

He capsuled management's job as being production with a profit, and described management's salient areas of responsibility as the five M's of money, machines, materials, men, and methods. To these he added the ever-important one of community participation.

In offering his concept of management efficiency evaluated at the small-plant level, Mr. Thomas emphasized the vital role of planning. Objectives of small-plant planning, he said, are a product with profit potential; a product with sales appeal; personnel with tool know-how; processing with efficiency and economy; facilities that abet the work force, production, and customers; and finally the location of the plant.

Well-known speaker at ASTE chapter meetings in both the United States and Canada, John W. Lengbridge, project engineer for Aluminum Goods, Ltd., Toronto, gave a paper on press room problems. His talk covered product development, project planning, development of blank size and shape, and tooling problems in working the metal to shape.

After the morning presentations by Canadians, two speakers from the United States gave papers during the afternoon to make the conference truly an "all-American" affair, in the words of its general chairman, William A. Dawson of Hamilton chapter.

The senior research supervisor of Cincinnati Milling Machine Co., E. J. Krabacher, talked on "Metallurgical Aspects of Machinability." Mr. Krabacher correlated physical properties and machinability by drawing a comparison of characteristics of two metals, titanium and steel. He explained, with the help of slides, the formation of various types of chips; the effect of tool geometry and the angle of shear on tool life; and the way in which microstructure and physical properties affect machinability.

Robert T. Hook, chief metallurgist for Warner and Swasey Co., presented a paper entitled "Ceramics—Tomorrow's Tools Today." It covered examples of experimental production machining with ceramic tools at both his firm's plant in Cleveland and at the Cameron Iron Works in Houston, Tex. The paper was accompanied by a 16 mm sound film, showing tests being conducted, cutting at 16,000 fpm. Mr. Hook made recommendations for the correct application of ceramics for a cutting tool.

Registrants were served lunch at the Collins Hotel in Dundas, a short drive from the campus. During the noon break, Chairman Dawson presented certificates of appreciation from the ASTE to Dr. J. W. Hodgins, director of engineering studies at McMaster, and to the day's lineup of speakers. Dean Hodgins hailed the Society's activities and aims and promised that the university's engineering school, now being built, would offer a specialized tool engineering curriculum to fourth-year mechanical engineering students.

Many of the conferees took time out during the day to inspect the 130,000-square-foot engineering building to be completed by April next year, and the mammoth circular bulk of concrete that will house the university's nuclear reactor.

John W. Lengbridge, project engineer with Aluminum Goods, Ltd., speaks on pressroom problems to 170 tool engineers at conference.

Exploring Space:

"The Means" discussed at Regional Conference

Space travel was the keynote of the Central New England Regional Conference held in Providence, R. I. With their feet planted firmly on the ground, 130 tool engineers let their imaginations soar into space under the expert guidance of satellite savant Professor Charles H. Smiley of Brown University.

A hydrogen engine provided power for the space vehicle in which the tool engineers made their tour with the professor. This engine, employing the same type of energy that is released in the explosion of a hydrogen bomb, was approximately 1000 times more powerful than the highest thrust rocket engine yet devised.

It had the unequaled advantage, moreover, of being able to refuel itself continuously by assimilating the free hydrogen that exists everywhere in outer space. "This engine is capable of taking us anywhere we want to go," the professor said. "It is only a matter of personal preference and the time we want to spend."

Mars or Venus would be suitable initial destinations, he noted, adding that ". . . after a New England winter, perhaps we'd just as soon pass up Jupiter." The temperature on Jupiter averages 400 degrees below zero. He was even less enthusiastic about going to Mercury, where high temperatures would "melt lead on the sidewalks."

Achievement of the engine is feasible at any time, the professor contends. It is possible that discovery of the necessary controls may not be nearly so difficult as now appears and may lie in an area quite far removed from those where research is currently being concentrated.

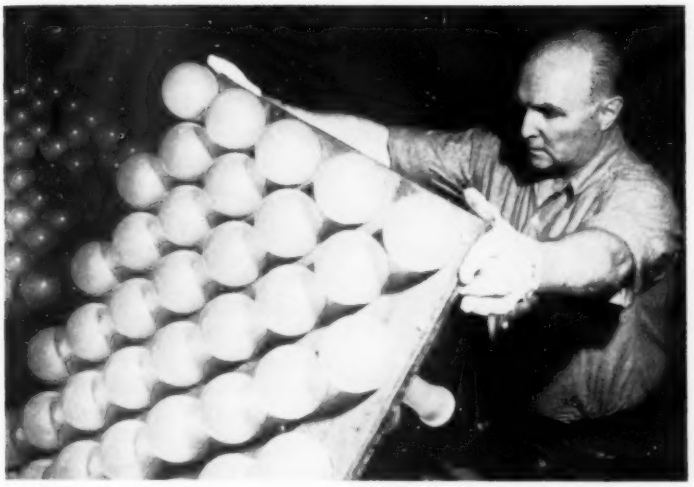
Advocating a "down-with-the-pillars-of-pessimism" theory for those who think we are irrevocably behind the Russians, Professor Smiley said that we can match or excel them if we work hard enough at it. The Russians are not all twelve feet tall intellectually, he believes, and, although they may put a man on the moon by 1960-1965, they have persons who are just as capable of making mistakes as some of our citizens.

Replying to the lively question period, the professor stressed the importance of electronics, mathematics and imagination in the field of education. He feels that with more freedom and more support for research, our educational institutions will make great strides into the future.

Dynamic Society leader, John X. Ryneska, left, gets a point across to past presidents "Rip" Collins and Irwin R. Holland.

Little Rhody's past chairman, Paul Watelet, lett, expedites the registration of conferees at the start of a busy day.

Ray H. Morris, a past national president, was master of ceremonies for closing banquet.



Many tool engineers observed close-up operations of plants on exhibit. A Corning Glass Works employee is shown here inspecting one of his company's many products.

Topics of the morning sessions included: "Nuclear Power," presented by Richard Delagi of Metals & Controls Corp.; and "Automation," by Professor Harland F. Stuart of the University of Rhode Island.

Four plant tours afforded the engineers an opportunity to view a variety of operations at: Brown & Sharpe Mfg. Co.; The Corning Glass Works; The Narragansett Brewing Co.; and The Providence Journal Co.

Past President Ray Morris emceed the banquet which brought the conference to a close. Past President Rip Collins gave a short talk and James Meehan, sales director of the grinding machine division of Brown & Sharpe Mfg. Co., delivered the after-dinner address.

Examining the displays are, from left: Robert Hurst and Richmond McKay, both of Union Twist Drill; and George Foy, chairman of Springfield chapter.

In addition to touring space, the New England tool engineers actively participated in plant tours. Pictured here is Frederick Dimock, Southeastern Massachusetts, who wonders if the temperature on Mercury is so much higher, after all, than the furnace he is examining at Corning Glass Works.

Exploring Space: Indiana Style

A WEEK before tool engineers in New England were introduced to the theories of a hydrogen engine to provide the "means" of exploring space, Indiana engineers attending the fifth annual Purdue On-Campus Conference got a prevue of the "ways" men will travel, once cut loose from the bonds of earth's gravity, by Col. John P. Taylor, assistant chief of the Wright Air Development Center's aircraft laboratory, Wright-Patterson Air Force Base.

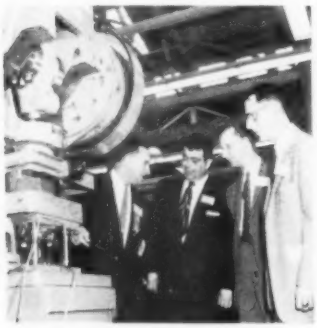
Col. Taylor's talk climaxed a day loaded with the sort of advanced technical information he cited as one of ASTE's more important contributions leading to our country's present advanced state of manufacturing precision and reliability, both necessary conditions in tooling for today's products as well as for those of the space age.

Talks on Advanced Techniques

Over two hundred Hoosiers and a few "outstaters" heard talks on such advanced techniques as using spiral point drills for better hole characteristics, as presented by G. C. Taffe, president of Cincinnati Lathe and Tool Co.; utilizing explosives as a metal-shaping tool, discussed by Capt. Paul J. Wolf, chief of Wright-Patterson Air Base's industry section; and the employment of numerical and tracer controls, explained by Fred W. Burdett of Giddings & Lewis. Conference Chairman and Organizer Orville Lascoe, of Purdue's industrial engineering staff, reported on recent press research studies made at the university. John McKeogh, development engineer for Wyman-Gordon Co., described advances in impact forging techniques and, completing the technical program, John R. Keates, representing National Automatic Tool Co., gave late-day information on automatic machines for short-run production.

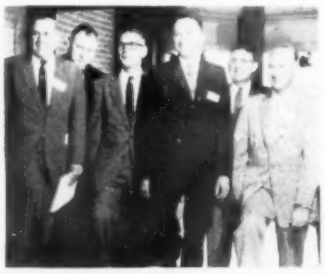
A bonus talk by C. H. Lawshe of Purdue's psychology department described good supervisory action as leading, not pushing, and illustrated this point by showing the different levels of participation a supervisor could offer his subordinates. Other guest speaker spots were filled by National Membership Chairman Carl Darger of Muncie, who presided at the luncheon; National Education Chairman Arthur Gould, who acted as luncheon toastmaster; D. R. Mallett, executive dean of the university, main luncheon speaker; and H. Dale Long, national vice president, who served as toastmaster for the banquet.

A program for visiting wives included a metalcraft exhibit, a tour of the new home economics facilities, with lunch in the "home ec" cafeteria, and a tour of inspection through the new recreational gymnasium on the campus.



O. D. Lascoe (left) prevues his talk on "Press Studies" which were made on the high-speed (1000 strokes/min) Minster press in the foreground, for the benefit of (from left) Theodore Hanson of Danly Machine Co. and Ted Wrona and Donald Seyfried, both of Minster Machine Co., makers of the press.

George Moore, Fairfield Mfg. Co., and Joseph Penn, national standards committeeman and a past chairman of the Indiana Council which sponsored the conference get the "pitch" about the Spiropoint drill sharpener from James Geier, Cincinnati Grinder representative. Other sponsors: ASTE's education committee and Purdue's department of industrial engineering and division of adult education.



Stepping into the morning spotlight for technical session duties are (from left): R. W. Wohlheuter of the Louisville chapter (non-Hoosier member of the Indiana Council) who presided; P. F. Chenea, associate dean, Purdue engineering schools; G. C. Taffe, president of Cincinnati Lathe and Tool; John McKeogh of Wyman-Gordon; H. T. Amrine, head of industrial engineering, Purdue; and D. C. Wedlick, Muncie.

Toastmaster Long congratulates Col. Taylor following his talk at the Purdue conference.

Squeeze Tubes and Algae Tanks forecast for Space Trips

by Suzanne Olson

Col. John "Pete" Taylor, air force expert on the exigent problems of space travel, cast the eerie aura of degravitation over his enthralled banquet audience by telling (and showing) them how they would eat, sleep, breathe, drink, think, relax and react when confined, weightless, within the close quarters of a spaceship cabin.

Pointing out that true weightlessness has only been experienced for very brief periods of time by a small handful of space "pioneers," (who, for the most part, had little taste for repeat performances, having suffered "extreme vertigo and disorientation") Col. Taylor reported the opinions of experts as hopeful that with suitable training and orientation, most humans can in time adjust to a weightless state.

The Big Squeeze

The problem of interplanetary meal-planning was presented to the women present, and solved with dispatch by the colonel, who produced several tubes of food concentrate to be squeezed directly into the mouth, in order to offset the hazard of "floating food." (Those who sampled the dehydrated cheese and bacon concentrates later, confessed they were "not bad.") Liquids would have to be directed mouthward with the help of plastic tubes attached to syringes, he said, then describing the antics of some of his cohorts who—in the interest of science, of course—had practiced drinking while standing on their heads. It was their hope that by learning to force water into their stomachs against the pull of one gravity, they could do as well under conditions of zero gravity.

The critical aspect of each ounce of weight becomes apparent when it takes a thousand pounds of thrust to place a one-pound mass into orbit. Disposal of body wastes and provision of adequate food, air and water for a trip around Mars, estimated to take two and a half years, takes on challenging proportions under these space and weight limitations. One elaborate solution would provide tanks of algae to recycle the air through photosynthesis, as plant life does normally on earth. Pure water would be provided by freezing it out of liquid body wastes, while the solid wastes, fed to the algae, might produce a limited source of fresh food replete, with essential vitamins and minerals, if a source of power equivalent to sunlight were available to actuate the photosynthetic process.

The effects of degravitation on muscles and nerves, blood and lungs, balance and thought processes were among other areas touched upon. Col. Taylor pointed out that, although beds would be theoretically unnecessary, the human body has been accustomed to sleeping with its own pressure directed down toward a bed. Would a man floating horizonally in a spaceship become a victim of insomnia if these pressure points were missing? Probably. And so the pressure must be applied artificially by strapping him to a light bunk of nylon webbing.

Doolittle Prediction

At the end of the address, the audience had been convinced that with such questions now being solved through research and experiment, it was indeed possible that certain events, cited by General James Doolittle recently as within the realm of probable accomplishment before the year 2000, could occur: An unmanned rocket landing on the moon; the landing of scientific instruments on the moon; a manned satellite orbiting around the earth with return to earth; a trip around the moon and return to earth, first unmanned, and later with a man aboard; a man landing on the moon with return to earth; the construction of a space platform; the landing of instruments on Mars or Venus; and the landing of a man or men on Mars or Venus with safe return to the surface of earth.

Leaders of Connecticut Tool Engineers Day met at the New Haven Country Club at the midway point of the event, to eat and to discuss how things were going. Among them were (left to right) Fred J. Dawless, past national membership chairman and toastmaster at the banquet that evening; Paul Dillberg, Hartford chapter chairman; Ray Morris, Hartford past chairman; Russell Applegate, New Haven, host chairman for Connecticut Day; Norris Green, Fairfield past chairman; Russell E. Drescher, Fairfield vice chairman; and John Brozek, New Haven past chairman.

10th annual Connecticut Day

For a state with such diversified industry—from lipstick cases to atomic submarines—Connecticut's tool engineers are remarkably close-knit. They presented their usual united front on May 22, when several hundred of the 1586 members in the state's four chapters attended the 10th annual Connecticut Tool Engineers Day.

New Haven was host for the daylong program which is perennially one of the Society's outstanding examples of chapter cooperation. Visitors came for the seven plant tours, the technical session, and dinner, not only from the long-established neigboring chapters of Fairfield County and Hartford, but from recently chartered Central Connecticut 148 as well. In addition, a sizeable delegation showed up from Poughkeepsie, N. Y.

Among the main attractions were conducted tours of the Joshua Willard Gibbs research laboratories of Yale University at New Haven. The tool engineers saw a powerful new linear accelerator constructed for Yale through a grant from the U.S. Atomic Energy Commission. Purpose of the $2 million, 138-foot-long installation, explained Dr. W. W. Watson of the physics department, is to probe the secrets of atomic nuclei. Heavy nuclear particles are accelerated at high velocities through the 90-foot-long tank, striking selected targets at the end of the tank. Results of this basic research are expected to be vital and potentially valuable to the nuclear industry.

Visitors were acutely cognizant of the signs, "Danger—Radiation," but were reassured by Dr. Watson that the huge yellow tube was inactive that day, and besides was insulated by a half-inch steel wall lined with copper.

The tool engineers were also interested in the versatile 15-man tool shop they found at the laboratories. Machines are mostly Yale-owned.

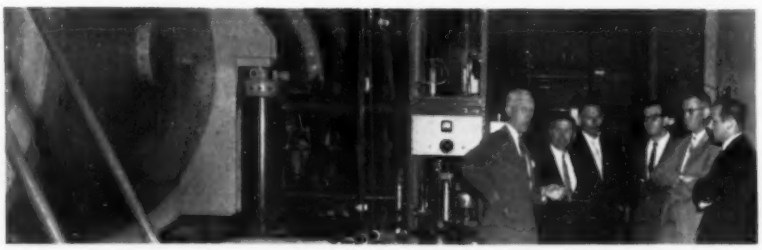
Four Host Plants

Other New Haven area visitations included the Wallingford Steel Corp., manufacturers of welded stainless steel tubing; the Geometric-Horton Div. of United Greenfield Corp., makers of self-opening and solid adjustable thread cutting dieheads and chasers, collapsible taps, and precision chucks; the Griest Mfg. Co. plant, manufacturers of sewing machine attachments, camera components, and various metal stampings; and the Farrel Birmingham Corp., Ansonia plant, where visitors saw carbide and ceramic tooling used in production of rubber working machinery and roll grinders.

Center of activities moved to Restland Farms in Northford, Conn. at 4 p.m. for a technical session and a new film on "Precision Broaching for Production and Profit." Participating were three experts on broaching from the Lapointe Machine Tool Co.: Joseph P. Crosby, vice president and director of Lapointe and a past president of the ASTE; George C. Bennett, plant superintendent, chairman of the national public relations committee; and Kenneth N. Macomber, chief service engineer of Lapointe's plant at Hudson, Mass., and internationally known lecturer on the subject.

Three hundred forty of the Connecticut tool engineers stayed for dinner at Restland Farms, and heard the principal speaker, T. A. Boyd of General Motors research staff, talk about the "Prophet of Progress," Charles F. Kettering. Dr. Boyd's long personal association with Boss Ket yielded an evening of wit and wisdom from the sayings of the famed bold thinker.

Guests included many area leaders of industry: Irwin Holland and Ray Morris, past national presidents of the ASTE; Francis J. Sehn of Detroit, ASTE national director; Joseph L. Petz of Poughkeepsie, national director; and Phil Marsilius of Bridgeport, national treasurer. The toastmaster, Fred Dawless, New Haven past chairman and winner of the chapter award of merit, paid tribute to Al Pollard, chairman of the first Connecticut Tool Engineers Day, who drowned in Florida last fall.



Explaining the intricacies of the 138-foot-long nuclear accelerator behind him is Dr. W. W. Watson of Yale University. Groups of tool engineers came through the research plant all day, and this one was comprised of (right from Dr. Watson) Earl Richardson, Fairfield chapter; Ray Pajer, New Haven; Donald Martin, Hartford; Carl Lundberg, New Haven, and R. T. Lawson, Jr., New Haven, publicity chairman for Connecticut Day.

Chapter takes Busman's Holiday

There's nothing a good tool engineer would rather do than go sightseeing in someone else's plant. And there's perhaps no other single chapter activity into which members put so much enthusiasm as they do into a plant tour.

With this propensity in mind, THE TOOL ENGINEER selected a typical chapter—if any chapter can truly be called typical—and trailed along with pen and camera after some 80 of its members as they took a busman's holiday from their homes and jobs in Canton, Ohio.

They got on their buses at Recreation Park of the Timken Roller Bearing Co. A two-and-a-half-hour ride over the rolling Ohio countryside brought them to their destination, and to dinner, in a clean, well-lighted place just outside the town of Bucyrus.

The plant was not at all typical.

In the Timken-Bucyrus plant, according to their host, Executive Vice President D. A. Bessmer, the tool engineers saw a factory as completely automated as anything in existence short of a chewing gum plant.

The members of Chapter No. 150, representing more than two dozen diverse manufacturing enterprises in Canton, returned home around midnight with a new respect for the potential in men and machines. At Bucyrus they had seen how one industry invested $12 million in the latest tools and processes, plus 13 years of thinking and work, plus ingenuity and individuality and incentive bonuses for even the window washers, to achieve the utmost in precision production. The highly mechanized plant produces 30 million roller bearings annually with a work force of 700.

Canton tool engineers load up for 90-mile ride to host plant.

Plant Manager Russ Fowler (right) explains the straight-line method used in the manufacturing process at Bucyrus to Past Chairman Jim Nickas and Chairman J. J. Babbo. A system of conveyors, chutes and elevators connects the different machine operations and, except for inspection purposes, none of the pieces are touched by workmen. The visiting tool engineers are standing by a No. 3 Ginn grinder on one of the 11 production lines.

Bob Irvin, a plant production supervisor, expounds on a toolroom operation for (left to right) Arthur C. Petit, Emil B. Logan, Morse E. Thomas, and Virgil Shelton. Carbide tooling is preground and preset in toolholders and made ready for immediate installation on all screw machines of the plant's production lines at scheduled intervals, to reduce machine down time.

A visitor's eye-view saw how an operator can complete up to 1200 cone assemblies in an hour. Magnetic elevator brings rollers into the feeder tubes that place rollers into cage. The assembly is put into the closing in the press at right. The finished assembly is ejected into a conveyor. An electric beam, broken by the hand of the operator, sets and trips the press.

Roger Waindle

members in the NEWS

Roger Waindle, president of WaiMet Alloys Co. of Detroit, and past president of ASTE, represented the Investment Casting Institute at the European Investment Casting Association meeting in Paris, May 18. Mr. Waindle discussed with European casting engineers the standardization of specifications and inspection requirements of castings produced in this country, and also led a discussion of U. S. production techniques.

Prior to his founding the WaiMet Co., a division of Consolidated Foundries and Mfg. Corp., Mr. Waindle was prominent in special alloy and diamond tool procedure developments at the Elgin Watch Co.

E. C. Nezbeda E. S. Phillips

Edward C. Nezbeda, member of the Long Island chapter of ASTE and chief tool engineer of Grumman Aircraft, was one of 37 young business executives named to receive a Sloan Fellowship for one year of study at the School of Industrial Management at MIT. Fellowship candidates are selected by their companies for having demonstrated executive ability and marked promise for growth. The program at MIT is made possible by grants of the Alfred P. Sloan Foundation, Inc., and will deal with detailed studies of the fundamentals underlying sound management practice.

Edwin S. Phillips, a past chairman and active member of the Pittsburgh chapter, has been elected president and chairman of the board of the newly incorporated organization of Phillips-Mason, Inc. Mr. Phillips is currently area chairman of the national standards committee, and vice president of the Middle Atlantic states regional council.

E. C. Newman James Rust

Another member in the Pittsburgh chapter, **E. "Clint" Newman,** who received the "most valuable player" service award for the 1957-58 chapter year, plans a nine-week business-pleasure trip to West Germany, Austria, Switzerland and Sweden to exchange tool engineering ideas with manufacturers abroad. His experiences will add flavor to his appearance as a member of the fourth annual small tools seminar, planned by the Pittsburgh group for this September.

James Rust, Santa Ana's current chairman, has assumed the position of works manager for the True Trace Corp. of El Monte, Calif. Mr. Rust was formerly a partner in the Prompt Tool and Mfg. Co., Los Angeles.

A 21-month assignment in Japan as manufacturing specialist for Lockheed Aircraft Corp. has been given to **Charles F. Swope,** San Fernando Valley member. Associated with Lockheed for 14 years, Mr. Swope started as machine operator and had progressed to the position of technical adviser in standard tooling, before his new appointment.

Arthur D. Lewis, left, and Anton Peck pose in the office of their new jointly operated company.

Two staunch West Coast supporters of ASTE—**Anton Peck,** past chairman of the Los Angeles chapter, and **Art Lewis,** past chairman of both the Los Angeles and San Fernando Valley chapters, and a past national director of ASTE—have announced the merger of their tool and die supply firms. Both men have had years of practical experience in the tooling field: Art Lewis as supervisor at Fisher Body Div. in Detroit and Anton Peck as tooling superintendent at Wedgwood Stove Co., Universal Metal Products, and Harvey Machine Co. They had both built up sizeable operations in tooling materials and components since the war, operating in related, though not competing lines. The two operations have been consolidated as the Peck-Lewis Corp., located in the heart of Los Angeles' industrial district. The two parent companies were the Art Lewis Production Co., Inc., and the Peck Steel and Die Supply, Inc.

In the National Spotlight

"Year of Action" planned by policy makers

Just 16 days after the close of the Annual Meeting, an enthusiastic and ambitious group—the Society's new officers and national committeemen—met jointly with the headquarters staff in Detroit to pinpoint the goals to be achieved in the next five years, and to plot the next 12 months' course of actions that would lead to such goals.

A sweeping program of educational opportunities for members—in the year directly ahead as well as over the longer five-year haul; the aspiring goal of 55,000 members by 1963; and probing reviews and improvements of present program planning and public relations activities, are but a few of the aims voiced by the policy makers.

In the words of Executive Secretary Harry E. Conrad, "This year is the year of action. We have good leadership—good officers, directors, and committee chairmen—and plenty of the enthusiastic spirit that has made and kept ASTE vital during the past 26 years. As a result of the leadership conference, and of this meeting, we know where we are heading. We need only maintain the head of steam thus far generated. By so doing, I feel confident that the objectives set here today will be carried out this year."

Salient points in the ambitious educational program to be tackled by Chairman Arthur Gould's committee are: extending the advanced tool engineering practices series to participation by six chapters; continuing the seminar program begun last year, with a proposed goal of ten seminars in the 1958-59 period; fostering a textbook survey on the subject of tool engineering at the college level, with recommendations to be turned over to the technical publications committee; and continuing emphasis on both the student chapter and on-campus conference programs.

Two further areas for investigation and future consideration by the committee deal with the proposal to set up one or more graduate ASTE fellowships for research in tool engineering, and a thorough study of the plan, with all its ramifications, to establish a resident ASTE education center for science and research.

Working hand in hand with the education committee, the professional engineering committee's first objective is to encourage the professional growth of the tool engineer, regardless of whether he becomes registered or not. Continuing efforts to promote the recognition of tool engineering as a profession by governing agencies is another important function of this group, under the leadership of Hugo Aglietti.

A soon-to-be-launched plan of the public relations committee, announced by Chairman George Bennett, will make new chapter members *better* members, by giving them a better grounding in ASTE lore, welcoming them officially at a regular chapter meeting, and inviting them to share the responsibilities, and thus the interests, of the chapter by immediate service on a committee of their choice. Mr. Bennett disclosed plans for a chapter bulletin contest, with the object of upgrading the quality of these publications, and announced that the chapter display units approved at the annual meeting were being readied for distribution, upon request and for limited periods, to chapters or companies where the units would draw the attention of prospective members to the Society.

The finance committee, headed by Verne Loeppert, announced tentative budget figures earmarked for the various committee activities during the year to come, and chairmen were asked to submit their requirements, based on these figures, for final approval at the semiannual meeting scheduled for October 1 and 2 in Los Angeles.

National committee appointments, complete in all but a few instances, were announced.

Installation night at Sinclair College. Dick Neibusch (left), national education committeeman, presenting the chairman's pin to Joseph Roush, charter chairman. National President George A. Goodwin is seated at right.

Sinclair College Receives 20th Student Charter

A new student chapter at Sinclair College, Dayton, Ohio became the first student ASTE group in Ohio and the twentieth in the United States and Canada. Society President George A. Goodwin, long-time member of the college's advisory committee on tool engineering, served as the installing officer, at a ceremony following a joint dinner meeting of students and members of the parent chapter of Dayton.

The student chapter's new officers are: Joseph Rousch, chairman; Charles Snead, first vice chairman; James Folk, second vice chairman; David Wisecup, secretary; and Edward Dodds, treasurer. Vernon Watson, engineering instructor at the college, will act as faculty advisor.

The college is an outgrowth of a program of formal education offered by the Dayton YMCA, back in 1887. The business, technical and general education classes suffered growing pains, became recognized and accepted by the Ohio educational department, and expanded until, in 1938, college-level curricula were instigated. In 1954, two-year cooperative programs in engineering technology and business administration were established. ECPD accreditation was granted the school's mechanical and tool engineering technology programs in 1957, just ten months before the chartering of the ASTE chapter.

Tomorrow's Tool Engineers

Long Beach Students Hear Bushing Experts

Bags containing drill bushings were passed out to the student audience of a technical session at Long Beach City College by Guest Speakers James Giles and Larry Elmendorf of the Ace Drill Bushing Co., to illustrate the extremely close tolerances that can be held in bushing manufacture.

Mr. Elmendorf described the uses of various types of bushings, and explained the vital part they play in mass production, effecting speed and accuracy in manufacturing at a reduction of cost.

In addition to the Society's student chapter, three of the college's drafting classes attended the lecture. The chapter's technical meetings are open to all students, in the belief that the benefits of attending such sessions often result in new members for the chapter, as well as a general recognition of the caliber of the Society, among the student body and faculty.

Wentworth Presents Prize Speaker Awards

An annual event of the Wentworth student chapter is a competitive presentation of technical papers by the members. Those competing must select their own topic, which is limited to some phase of tool engineering used in industry today, must gather the necessary material, annd successfully deliver it to an audience of fellow members.

Selection of the winners is by secret ballot of noncompetitors. Content and completeness of coverage, plus competence of delivery, are the criteria for judging.

A first year student in mechanical engineering technology design option, George Beaman, was voted first place winner for his presentation of "Rolling Threads" by the student judges. Robert Norton in the same option, took second place for a talk on "Chain Drives." A *Tool Engineers Handbook* and a *Die Design Handbook* were the prizes.

Canton Ag and Tech

The DoAll Company's "Story of Measurement" was presented by C. G. Shelley to an audience comprised not only of student chapter members but also of students and faculty from St. Lawrence University and Canton High School, and representatives from local industry.

Hudson Valley Tech

Students at HVTI joined Hendrick Hudson chapter early in the year to hear Past President Harry B. Osborn, Jr., technical director for Tocco Div., Ohio Crankshaft, speak on the subject of "Tooling for Induction Heating."

Alfred Tech

B. W. Crandall of the university's college of ceramics spoke on "Guided Missiles" before the student chapter, following a spaghetti dinner.

Ronald D. Graves, freshman mechanical technology major at Canton Ag and Tech, is the recipient of one of the $400 ASTE education awards. Twenty-two awards, at both the college and technical institute level, add up to a $12,000 investment by ASTE in the development of "tomorrow's tool engineers." —*James S. Downing*

KALAMAZOO—C. A. Elzinga, area captain of the national membership committee, presents membership contest award to Chairman James R. Wagner of the winning chapter, Western Michigan #38. The Grand Rapids group increased their paid-up membership by 25 percent from Aug. 9, 1957, to May 1, 1958, during the contest with Kalamazoo, Benton Harbor, and Muskegon chapters. Award meeting was held in the new Western Michigan University Center Building with 130 in attendance, including Carl Darger and John Pridgeon of the national committee.

chapter news and views

Detroit Holds 2nd Campus Tool Engineering Conference

A day-long program of "advanced technology for the manufacturing industries" was held by the Detroit chapter in mid-April on the campus of Wayne State University, with luncheon and dinner sessions at the nearby Engineering Society of Detroit.

Morning sessions covered: "Tool Control Systems" by V. P. Masi, Chrysler, moderated by George E. Demorest, professor at Wayne; "Transfer Machines" by D. E. Hawkinson, Greenlee Bros., moderated by Gordon E. Rivers, Wayne State professor; and "In-Process Gaging" by C. Brooks, Sheffield's Autrometrology, Div., with Russel Bearss from Chrysler, moderating.

In the afternoon, L. F. Christensen of A-C Spark Plug spoke on "Methods and the Tool Engineer"; J. C. Chapman of Chrysler covered "Quality Control and the Tool Engineers"; J. Brown, Ford Motor Co., described "Production Control"; and Robert Breisch, Chrysler Corp., talked on "Casting and Forging Engineering." Moderators for these meetings were C. L. Brisley, Wolverine Tube; Anthony Rogers, Wesson Co.; R. S. Jones, Wayne State professor; and also from Wayne, N. M. Lazar.

Luncheon Speaker J. S. Johnson, dean of Wayne State University's college of engineering, asked for acceptance by industry of the basically-trained college engineering graduates, for the good of a company's future, rather than their more short-sighted employment of specialized technicians, whose usefulness as operators of present-day devices would decrease with the obsolescence of today's methods and machinery.

The dinner meeting was brightened by three excellent speakers; Toastmaster Stan Commer, of Ford Motor Co.; Chrysler Training Center's F. W. Parker; and Milton Brand, of Burroughs.

DETROIT—Wayne State University campus was the scene of the chapter's second tool engineering conference. Above, Eugene Makie, moderator of the session on the "Building Block Principle in Machinery Standards" clears up a point with the speaker, Henry Daum. Both with Ford Motor Co., Mr. Daum is manager of machining processes, while Mr. Makie is manager of manufacturing engineering. This session led off the morning.

PEORIA—R. E. Kidd, training supervisor of Caterpillar Tractor Co. arranged the above display for the Pekin Science Fair to stimulate interest of high school students in tool engineering. This was Peoria's third year of participation in the fair. The display illustrated various manufacturing processes from gear blank to finished gear with tools, layouts, and a setup showing a hob actually cutting the teeth of the gear.

N. L. Bean Addresses Dayton on Russian Trip

Two hundred and seventy members and guests of the Dayton chapter of ASTE turned out for a past chairman and executive night program. Chapters from Richmond, Indiana and Springfield, Ohio, joined in the event.

The evening's spotlight was turned on National President George Goodwin, Dayton member, who spoke on the "National Organization's Aims and History," and on Nevin L. Bean, who, as featured speaker, informed his audience of his personal observations on "Automation in Russia", gleaned while on tour as a representative of the State Department. Mr. Bean, assistant to the president of the Ford Transmission Div., Detroit, described many interesting manufacturing installations in use behind the iron curtain.

Tooling Lab Course Offered in Indianapolis

The technical institute division of Purdue University at the Indianapolis Center is sponsoring an eight-session machine tool laboratory course during the early summer. Cooperating in the effort is the university's industrial engineering department and the Indianapolis chapter of ASTE.

The course, designed to acquaint students and industrial personnel with the use, limitations, and tooling of general purpose and production machine tools, will provide a good background for job hunters interested in employment in the tool engineering field. Additional information on the classes, scheduled for consecutive Saturdays from June 14 to August 2, can be obtained by writing Purdue University Center, 902 North Meridian St., Indianapolis.

Northwestern Pennsylvania

A talk on hot extrusion of steel, accompanied by a movie, was given by Lamar Hugo, senior sales representative for Jones & Laughlin Steel Corp., at the April 3 dinner meeting.

St. Louis

Ruggeri's Restaurant was the scene of the May technical meeting where Allen S. Black, technical engineer with Fellows Gear Shaper Co. presented a film and lecture about gears and gear-shaping equipment. An especially interesting feature of the film illustrated the development of involute gear teeth and the action of gears. Through the use of plastic models and polarized light, stress distribution was clearly shown.

Williamsport Presents Nine Student Awards

April saw the second annual presentation of trade awards made by members of the Williamsport chapter to students in the tool trades at Williamsport Technical Institute. Nine awards were made in all, with first, second and third place awards going to students in three different categories: high school toolmakers, adult toolmakers, and adult tool designers.

Men receiving the awards, listed first, second and third, were: high school toolmakers—Jack Welshans, William Zimmerman and George S. Schneider; adult toolmakers—Phillip H. Swartz, Earl L. Parrish, and Lewis Kough; adult tool designers—John Upliger, Antoine Accristo and Albert Botto.

All of the awards included framed certificates of achievement. In addition, the second place winners received a Tool Engineers Handbook, and the first place winners, both the handbook and a year's membership in the Williamsport chapter.

Judging committee consisted of Stanley J. Gartner, Sylvania Electric Products, Inc.; C. H. Buddenbaum, Avco Manufacturing Corp.'s Lycoming division, and H. M. Bingman of Piper Aircraft. —*William S. Beach*

Calumet Area

"Plastic Tooling—Its Successful and Economical Adaptation" was the subject of a talk by H. F. Hobson, chief tool engineer of Kish Industries, Inc., at the installation meeting.

chapter activities

ANN ARBOR AREA—Chairman Ira L. Montague presents lapel pin to Don Holloway for his efforts in getting new members. Mr. Holloway served as guide during a recent tour of Ford Motor's Rawsonville plant, where visitors saw powder metallurgy in use.

LIMA—Student Donald Campbell (center) received a scholarship to Ohio Northern University engineering school from Chapter #97 at a meeting April 17. Left is Dean Archer of ONU, and right is Chapter Chairman Gene Siferd.

Keystone

Forty-five members met May 19 for executive meeting and dinner. R. Wolever, director of training, and Kenneth Nealon, design engineer, had charge of the plant tour at Eureka Specialty Printing Co. The members saw an automated printing, perforating and shearing machine, as applied to specialty printing from roll to packing in shipping cartons.

Long Island

"The Use of Wire Construction in Product Design" was the subject of a talk by T. W. Whipple, vice president in charge of sales at E. H. Titchemer Co., Binghamton, N. Y., March 10.

London & St. Thomas

Clifford T. Appleton, Reed Rolled Thread Die Co., acquainted more than 80 members and guests at the March meeting with the possibilities of thread and form rolling. He brought with him exhibits which showed remarkable advances over the past few years.

Philadelphia

The 20th anniversary was celebrated April 17 with 100 members present at the Engineers Club. Charter Chairman Connie Hersam gave a short talk on the progress of the chapter from the beginning when there were 44 members, to the present group of 769. Past Chairman Tom Donovan, also a charter member, installed the new officers for the coming year. E. W. Dickett, engineer, Sundstrand Machine Tool Co., talked on "Engineered Turning Production."

Twin Cities

During the afternoon of April 3, 115 members visited Scott Atwater Mfg. Co., where they observed all phases of this company's operation, including the manufacture of parts, assembly finishing, testing, and packaging of outboard motors. At the conclusion of the tour C. Peterson, superintendent of production, and H. Kraemer, works manager, addressed the members.

After the Scott Atwater tour, members traveled to Mound, Minn., for dinner at the Casino Restaurant, where guest speakers from Tonka Toys Mfg. Co. were G. Batdorf, vice president and treasurer; R. Wenkstern, vice president in charge of tooling; and W. Roberts, personnel manager. After dinner, members toured both plants of Tonka Toys.

Santa Clara Valley

Seventy-four members met May 20 to hear Glen H. Stinson, chief engineer and manager of sales, Gage Div. of Greenfield Tap and Die Corp., speak on "Gages: Watchdogs or Bandits for the Millionth Part of an Inch." His talk pointed out the importance of the millionth part of an inch, as it affects national and world production.

San Francisco

Byron R. Russell, Airline Welding and Engineering, spoke at the technical meeting April 24, on production welding. Mr. Russell described methods of fusion butt welding with automatic machinery that positions, chucks, moves and ejects finished tubes and cones. His talk was illustrated by films showing methods and techniques used in accomplishing more difficult jobs.

chips and chatter

Oakland County

At the regular dinner meeting on May 19, Otto Schellenberger and G. A. Mason of Thor Power Co. talked on the use of portable power tools. Movies were shown, followed by a question and answer period.

Cincinnati

The *twentieth* annual dinner of the southern Ohio chapter was attended by 376 members and guests, who heard Kurt O. Tech, vice president of The Cross Co., speak on the engineering approach to human relations. Prominent guests who shared the speaker spotlight were ASTE Vice President William Moreland of the Mansfield chapter, and Ohio Supreme Court Judge James Garfield Stewart, an honorary member of ASTE.

Portland, Me.

"Progressive Dies" was the subject of a speech given by Herbert F. Jahn, president of The B. Jahn Co., at the April 14 meeting. Mr. Jahn pointed out that in progressive construction and design, zigzag feed is feasible and in use.

Chips and Chatter

Indianapolis

One hundred seventy members met May 1 for the father and son meeting. Duane Carter, director of competition, U. S. Auto Club, discussed racing and race cars, tires and chassis design. Sid Collins, sports commentator for radio station WIRE, was emcee for the after-dinner program.

Mississippi

A. B. Williamson, vice president-general manager for McGill Bearing Co., spoke at the May 5 meeting on "Techniques in the Manufacture of Ball and Roller Bearings." He took note of the competition in bearing manufacturing between European and American companies, and showed slides portraying the rapid rehabilitation in Europe.

Western Michigan

At the meeting for installation of new officers, presentations were made by L. Galloway of the local Junior Achievement Organization on the work of JA in Grand Rapids; J. Kroon, on the process of vacuum forming plastic sheet in the manufacturing of juke boxes at A.M.F., Inc.; and S. Barrett of Die-Draulic Grip., Inc. on the Die-Draulic method of punch press drawing operations.

Portland, Ore.

The executive committee met May 15 at the Willamette Iron and Steel Co. Members discussed raising the cost of ads in the monthly bulletin to build up the treasury with the idea of someday having a local scholarship. Chairman Bill Simpson reported on the Convention in Philadelphia.

Kansas City

At the April 16 meeting members heard Leslie C. Seager, chief production engineer, Elmco Corp., and former member of the national professional engineering committee, speak on "Establishing Tool Engineering Curricula in Our Colleges." Mr. Seager told how he had been instrumental in instituting fully accredited curricula at both Utah State College and Westminster, where he served as president of the Utah Engineering Council. A group discussion was held on how to obtain more recognition of tool engineering in both high schools and colleges.

Monadnock

One hundred twenty-two members, at a joint meeting with Twin States chapter, heard Horace D. Gilbert, president of Miniature Precision Bearing, Inc. speak on "Miniaturization" at the May 15 meeting. Mr. Gilbert stressed the importance of the use of miniature bearings, which insures lightness, high precision, and more compact devices. They are used, he said, by all branches of the armed forces, by manufacturers of office equipment, computers, and instruments, and by many others interested in making small, precise parts.

After a movie, "Magnificent Miniatures," the group toured the Kingsbury Machine Tool Co., site of the meeting.

Golden Gate

Pat Carter, field engineer for Sunnen Products Co., spoke on "Today's Tolerances and Finishes Call for Honing" on April 16, at the first meeting held under the supervision of the new officers. His technical discussion was highlighted by case histories and a movie.

Los Angeles

One hundred thirty-nine members and their guests at the April 10 meeting heard E. J. Urbach, head of reports on rockets projects at Aerojet System Div., review the U. S. earth satellite program. He covered the background, planning, and current activities of the U. S. participation in the IGY program, with particular attention to the rocket vehicle for the man-made moons.

Little Rhody

Paul S. O'Neal, field engineer of Bakelite Co., Union Carbide Corp., spoke on "Proper Perspective on Plastics" at the May 1 meeting at Johnson's Hummocks Restaurant. Mr. O'Neal discussed the properties of various plastics and their uses according to these properties. Of particular interest were the epoxy resins which, alloyed with metal fibers, can be used to fabricate inexpensive punches and dies, chuck jaws, etc.

Nashville

After thejr dinner meeting April 15, members toured the Nashville Ford automobile glass plant, the world's largest, where they were able to follow the production line from furnace to shipping.

Worcester

The unexploited versatility of the so-called "workhorse" of the machine shop, the radial drill, was pointed out to Worcester members by John Hussey, sales engineer for the American Tool Works Co. of Cincinnati. A great variety of machining operations—drilling, reaming, tapping and even boring holes—can be accomplished with the aid of a trunnion stand and jig, Mr. Hussey said. Instead of moving parts to another machine and a new setup, a change in the type of cutting tools is effected with usual time saving of from 75 to 90 percent over the usual method.

Consistent accuracy—a potential of one thousandth of an inch between holes in the heavy machine castings—is built right into the jig and the tools, he said.

SPECIAL EVENTS

ASTE West Coast Tool Show.
Sept. 29-Oct. 3, Los Angeles Shrine Exposition Hall.

ASTE 27th Annual Meeting.
April 18-22, 1959, Schroeder Hotel, Milwaukee, Wis.

Obituaries

Aircraft Executive Dies in New York

George H. Hauser, veteran of 40 years in the aircraft industry, succumbed to a heart attack just days after the announcement came of his appointment as assistant to the president of Republic Aviation Corp. His new position was to have been chiefly concerned with community relations.

In the educational field, Dr. Hauser was a member of the executive committee of New York University's Arts and Engineering Alumni Association; a director of its Alumni Federation; member of the board of trustees, Hofstra College; and chairman of the Nassau County Commission on Collegiate Education.

In addition to Dr. Hauser's affiliation with the Long Island chapter of ASTE, he belonged to the AOA; American Rocket Society; Institute of Aeronautical Sciences; ASME (life member); and Princeton Engineering Association. In 1950 Dr. Hauser received his LLD degree from New York University.

William D. Brewer, Oklahoma City, chief engineer for Oklahoma Gas & Electric Co.

William Farrell, Twin States, retired general purchasing agent for American Locomotive, New York, N.Y.

Shubel A. Foster, Detroit, president, Foster Engineering Corp.

Floyd R. Hoaglin, Lansing, chief tool engineer, Motor Wheel Corp.

Wilhelm K. Meyer, Santa Ana Valley, tool engineer at Clifford Mfg. Co.

Fred A. Savage, Macomb County, supervisor for Continental Can Co.

Paul N. Shaw, Cleveland, president of Positive Safety Manufacturing Co.

Herbert S. Snodgrass, Des Moines, general manager for Neo Ray Products.

Oliver T. Spear, Indianapolis, design engineer for Mertz Engineering.


AMERICAN SOCIETY OF TOOL ENGINEERS

This certifies that

Harvey M. Bowes

Being duly qualified, has been elected, on April 23, 1946 a Senior Member in this Society, an organized and functioning institution for the advancement of scientific knowledge in the field of Tool Engineering.

In Witness Whereof we have hereunto set our hands and affixed the seal of this Society.

Above is the new ASTE membership certificate, an attractively redesigned version of the former model. The blue-and-gold-trimmed "shingle" is available free from Headquarters, upon individual request on the order blank below. It can also be ordered framed at a cost of $2.

Order Blank for Membership Certificate

Membership Certificate Department, ASTE
10700 Puritan Avenue, Detroit 38, Mich.

Please send an unframed membership certificate to my chapter membership committee chairman for me. I understand that there is no charge for the certificate.

PLEASE PRINT NAME IN FULL .....

MEMBERSHIP NUMBER .....

CHAPTER NUMBER .....

CHAPTER MEETINGS

PLACE	July	SPEAKER	SUBJECT
Evansville. Ruthenberg Field. 6:30 pm	14		
Kalamazoo. Allen's Outpost. 7:30 pm	24		Annual picnic
Milwaukee	10		Board meeting
North Texas. Western Hills Inn, Highway #183. 7 pm	11	Turco Products representative	Chemical Milling
Racine. Lincoln Field. 2 pm	12		Family picnic
San Gabriel. Rainbow Angling Club. 7:30 pm	3		Panel on Shell Molding
Santa Ana. Palms Restaurant, Anaheim. 7:30 pm	1		Three scholarship awards to junior college graduates
Santa Clara Valley. Schick Products, Inc. 6 pm	15		Plant tour
Sydney, Australia.	9	Courtesy of the Japanese Embassy	Films on "Steel and Textile Industries in Japan"

Progress in Production

SPLINE ROLLING TECHNIQUE FOR TUBULAR PARTS

Recently developed tooling by Michigan Tool Co. for its Roto-Flo cold-rolling machines now permits simple, quick and inexpensive production of splines or serrations on tubing ranging from ½ to about 2-in. OD. Reciprocation of cylindrical forming racks is combined with an axial feed of the blank to cold roll splines of any reasonable length. Results are thin-walled tubular parts with rolled splines and serrations. Conventional methods (shaper cutting or hobbing) are time consuming and expensive.

Setup is versatile for this long-needed faster production method, and any length splines can be formed on solid-shaft parts, as well as tubular parts. Currently splines and serrations up to 12 in. long are being cold rolled with the process. Because required rolling pressures are relatively low, thin-walled tubular parts having as little as 0.075 in. from the root of the tooth to the ID of the tube can be splined or serrated. A mandrel type headstock center prevents distortion of the tube's inside diameter.

Rack Design Gives Advantage

The setup for spline rolling of tubular parts works in the same general manner as Roto-Flo spline rolling of solid shafts. Racks, however, are considerably different—they are now round with equal size forming teeth. The racks are reciprocated over the part in a relatively short but fast travel. For teeth having either a 30 or 45-deg PA, these racks generate tooth form identical to that which would be produced by hobbing action. Separating force is 3000 to 4000 lb. As the reciprocating racks follow a straight path, the part is axially fed a predetermined distance until the desired spline length is obtained. The axial feed rate of the part is from 1/16 to 1/8 ips, depending on part diameter, pitch and finish. The method permits the rolling of splines on undercut parts. For parts having shoulders the rack can be notched so that full depth teeth can be formed to within ¼ in. of the shoulder. Simplicity and high-use factor of the forming racks minimizes tool costs per part.

CERAMICS AT HIGH SPEEDS

Machining studies at the Metallurgical Products Dept. of General Electric are revealing some of the protentials of ceramic tools. With a specially constructed lathe, capable of producing cutting speeds up to 18,000 fpm, ceramic tools are undergoing extensive tool life testing.

The studies reveal that at extremely high speeds, ceramic cutting tools have good tool life characteristics. Results indicate that the savings in machining time resulting from the high speeds offer possibilities for savings in total machining costs with increases in machine productive capacity.

Machining at high speed with a ceramic tool on the special ultrahigh-speed lathe. The lathe is capable of producing cutting speeds up to 18,000 fpm. A plastic enclosure is required to contain the chips which are thrown off with considerable velocity.

The lathe itself is the only one of its kind known to exist and is powered by a 150-hp motor. Speeds range from 250 to 5000 rpm. All controls and instrumentation are located remote from the machine.

BUILT-IN COILS WIDEN PLATE USE

Possibilities of use of heavy composite plate as a heat transfer medium are considerably broader with development of a special vacuum cladding technique. Channeling of heavy base plate—normally steel—before the alloy or nonferrous cladding layer is applied, forms coil-like passageways for cooling or heating mediums in the heart of finished clad plate at a predetermined distance from either surface. Result is Channeled Hortonclad, a plate with integral internal coring that can frequently substitute for surface coils or double wall construction.

Pattern for channeling is almost irrelevant according to Chicago Bridge & Iron engineers where the technique was developed. Channel layouts for large plates often are divided into independent coil-like sublayouts either to give independent temperature regulation over different sections of finished material, or to reduce pressure drops of coolants and heating liquids by having several coils in parallel rather than in one labyrinthine path. Connections are made to channels inside finished plate through drilled and tapped holes in the base material.

Although vacuum cladding of the internal channels permits metallurgical freedom in choice of base material and clad surface compositions, most popular base materials are the low carbon steels.

To develop hardened clad surfaces to resist wear merely calls for cladding metals which either are inherently hard or can be hardened by air or liquid quenching from the manufacturing temperatures.

PARTS FROM EXTRUDED BAR LOWER PRODUCTION COSTS

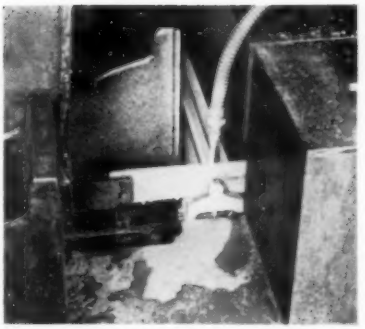
Production cost in manufacture of clutch pawls was cut by almost one-third through use of hot extruded-cold-drawn steel bars to replace machining from rectangular bar stock. The pawls are made in lots of about 150 pieces. In this specific case, use of steel bars extruded in the shape of pawls added 20 cents per part to cost of the material, but machining cost was cut $4.60 per

piece. Time slashes amount to 2 hours, 22 minutes for setup time and 24 minutes per piece in machining time.

Savings also are netted in scrap comparisons. Use of an extruded steel shape has reduced blank size from approximately 10 oz for a blank sawed from a $1\frac{3}{4}$ x $2\frac{3}{4}$-in. rectangular bar to approximately 4 oz for a blank from extruded steel shape. Blanks are $\frac{7}{16}$ in. thick.

Only about $\frac{1}{2}$ oz of material now needs to be machined from each piece, as compared with the $6\frac{1}{2}$ oz which formerly had to be removed.

Necessity for profile and plain milling, both of which were required to achieve the contour in the rectangular blank, has been eliminated.



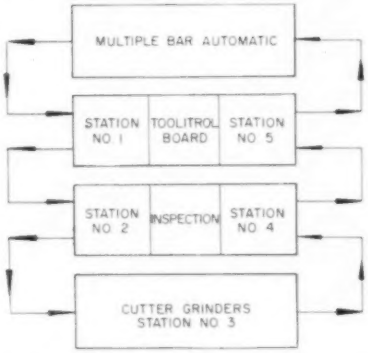
Clutch pawl blanks $2\frac{1}{2}$ in. wide are sawed from a hot extruded steel shape produced by Jones & Laughlin Steel Corp. for use on Jones & Lamson universal turret latches.

MANUFACTURERS STUDY TOOL CONTROL TO STANDARDIZE MACHINING PRACTICE

In an effort to improve and standardize machining practice for multiple-spindle automatic bar machines, seventeen manufacturing concerns have jointly sponsored a cooperative machining project (Comapro). The purpose of the project is to demonstrate possibilities for control of six basic production elements: material, tools and holders, measurements, coolants and lubricants, the machine itself and operating personnel.

A part representative of usual multiple spindle operations was selected for study and conditions were prescribed for optimum production results. Allied equipment for tool maintenance was selected carefully to elminate human error as much as possible. Full scale tests were conducted at Cone Automatic Machine Co. to allow accurate time study for verification of the validity of the methods and procedures.

A tool control system (below) was developed to realize the maximum efficiency from the bar machine by reducing down time for tool changing and minimizing scrap production.



Tool Control System for Perishable Tools

Station No. 1
1. Dull tool removed from holder.
2. Dull tool given a protective covering.

Station No. 2
1. Dull tool checked for:
   a. Tool wear
   b. Built-up edge
   c. Chip clearance and flute length
   d. Remaining tool life
   e. Cracks
2. Dull tool given a protective covering.
3. Dull tool may be scrapped at this station.
   a. For any reason given under Station No. 2 and new tool requisitioned

Station No. 3
1. Dull tool sharpened to print.
   a. Print to specify:
      (1) Type and brand of grinder
      (2) Grinding wheel size, grit, etc., both roughing and finishing
      (3) Grinding fixture number if required
      (4) Microinch finish
      (5) Resharpening to be wet or dry. If wet, give type or brand of coolant

Station No. 4
1. Sharpened or new tool checked for:
   a. Cracks
   b. Minimum and maximum length
   c. Dimensions
   d. Hardness
   e. Finish
2. Sharpened or new tool given a protective coating.

Station No. 5
1. Preset tool in holder for length or projection.
2. Store in Toolitrol Board in proper position.

FASTER PRODUCTION WITH FLUXING INNOVATION

Fluxing of parts with awkward contours has been speeded up through an ingenious method devised by production engineers at Fenwal Inc. Result of the new setup is a fluxing rate of about 8 seconds per piece.

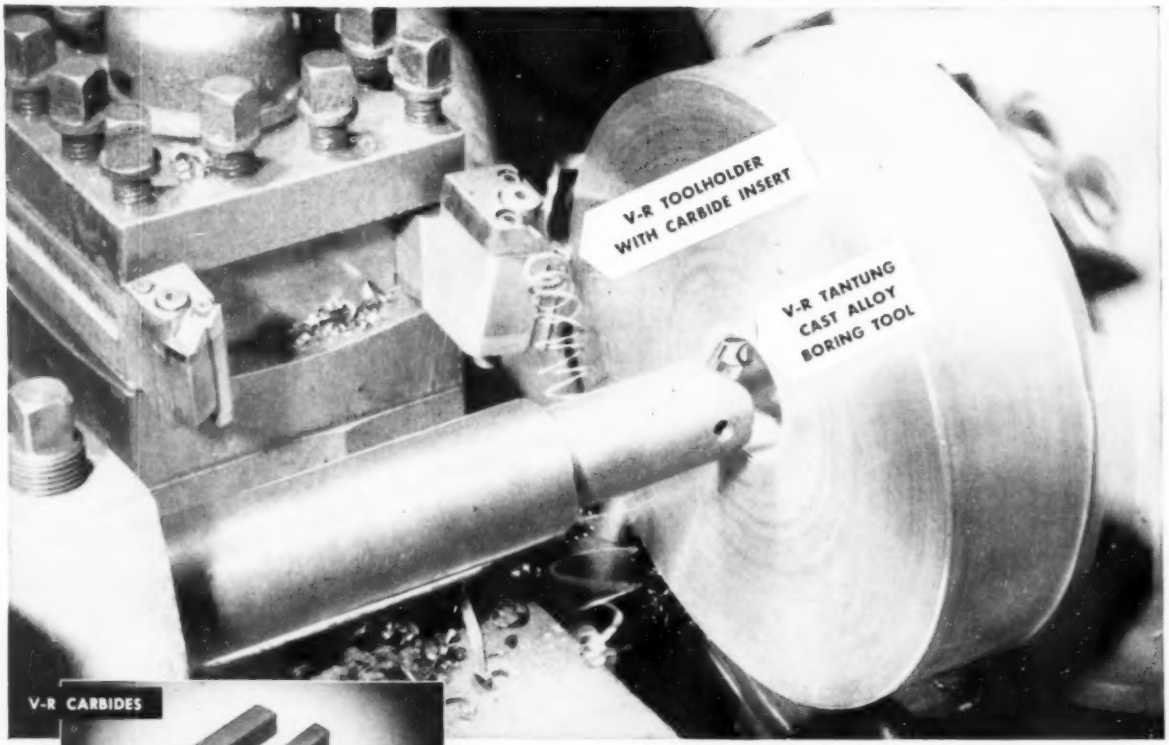
A part typical of the type involved is a stainless steel aircraft fire detector which has a triangular flange mounted on a cylindrical shell. During subsequent torch brazing with a Handy & Harman silver alloy, flux serves as a protective coating to prevent oxidizing of the stainless steel. However, the hand brush method used to apply the flux proved a bottleneck because of the awkward hand positions required to flux upper and lower surfaces of the flange, as well as the areas of the adjacent shell. Because the assembly is open at the end, dipping also is impractical.

Solution of the problem came with a motorized fixture which holds the part in the horizontal plane and rotates it between a pair of flux brushes. End of the shell is inserted in a collet mounted on the shaft of a fractional horsepower motor which rotates at about 45 rpm—a speed low enough to prevent the flux from spraying off by centrifugal action. Collet ID is about $\frac{1}{8}$-in. oversize to permit the shell to be slipped in and out freely, and is long enough to support the shell for about $\frac{2}{3}$ of its length to prevent excessive play during rotation.

In this fluxing setup, a motorized fixture rotates a part between brushes simultaneously. Brushes installed in the ends of ¼-in. tube bent to form a handle by which the operator controls flux application.

Fluxing brushes are held in ends of a ¼-in. tube bent around to straddle the flange. Pivoting freely on an axle, the brush holder is slightly overweighed at the front end so that the brushes dip into the trough of flux when the operator releases the handle. Thus the brushes swing out of the way when the fixture is being loaded, and are always covered with flux ready for use. In this fluxing setup, a motorized fixture rotates a part between brushes, which flux both surfaces of the flange simultaneously.

How Multiple Tooling with Carbides and Tantung Cast Alloy Can Reduce Machining Costs



Surface Speed Dictates Choice of Tool

The boring and turning operations on normalized oil hardening tool steel pictured above illustrate the economies possible by correct use of both carbide and cast alloy cutting tools. The 8" O.D. is being turned at 450 surface feet per minute (215 RPM) with a V-R toolholder and throwaway carbide insert. The boring speed is 112.6 SFPM on the 2" I.D. At this lower speed carbide tool life is drastically reduced by build-up, while H.S. steel tools fail prematurely because of excessive heat.

The answer is to use V-R Tantung cast alloy for the boring operation. At 112.6 SFPM Tantung tool life is markedly superior to carbide or high speed steel. The reduction in regrinds and downtime results in higher production and major cost reduction.

Vascoloy-Ramet manufactures a complete line of both carbide and Tantung cutting tools to provide maximum machining economy on any job. For complete details and CATALOGS, call your V-R Representative or Distributor or write to V-R today.

FREE Surface Speed Table and Tool Selector Chart

This handy chart shows the general cutting speed range for HSS, TANTUNG and CARBIDES . . . shows RPM for various diameters to deliver surface speed desired. Ask for your copy—no obligation.

MANUFACTURERS OF:
CEMENTED CARBIDES, TOOLHOLDERS and TANTUNG® CAST ALLOY CUTTING TOOLS

Vascoloy-Ramet Corporation

SUBSIDIARY OF FANSTEEL METALLURGICAL CORPORATION

866 Market Street • Waukegan, Illinois

CT-607

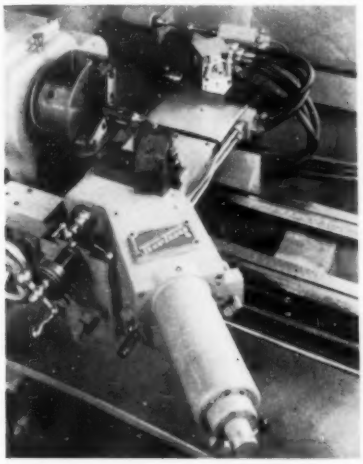
TOOLS of today

Tracer Attachment

A lathe tracer attachment is adaptable to almost any make of lathe. With it, relatively unskilled labor can perform such turning applications as step shaft tracing, contour turning, and facing operations.

The attachment converts standard lathes to contour machines, while also allowing normal turning by the lathe, because the cross and longitudinal screws are intact.

The attachment, which is based on the True-Trace 180-deg single dimen-



sion tracer, has: cross and tool slides, these cast of Mechanite and finished to precision tolerances; a Nitralloy insert in the lower slide; built-in oil reservoir; ability to use round or flat templates; self-contained hydraulic power unit; and fluid metering valve on the control cylinder.

True-Trace Sales Corp., 9830 E. Rush St. El Monte 50, Calif. **T-7-1**

Drill

The Depthmaster "down-the-hole" drill is designed to provide continuous hole-cleaning air to keep the hole clean and the drill free. Should the drilling operations stop and the drill be shut off, continuous high-pressure hole-cleaning air continues to pass through the drill and the bit, keeping the hole clean and minimizing sticking of the drill in the hole.

All operating air is exhausted through the bit, and there is no need for special exhaust ports in the side walls of the cylinder.

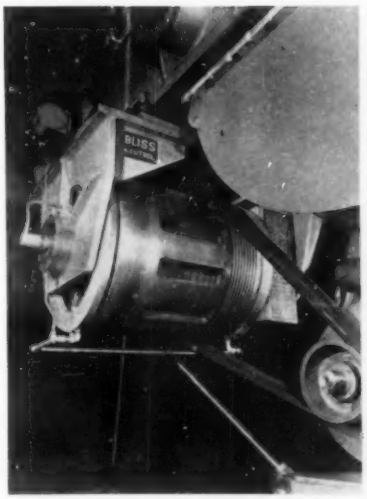
The drill is manufactured in three sizes for blast holes from $4\frac{3}{4}$ to 7 in. The tool is available to users of other drilling equipment.

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y. **T-7-2**

Electronic Press Drive

The Accutrol electronic press drive permits reverse jogging of a press without stopping and reversing the motor. Jogging torques and speeds are adjustable.

In this design, too, normal clutching and braking are controlled by a servosystem which electronically compensates for thermal and kinetic variations. The Accutrol brakes against itself by using alternating current to create a reverse rotating magnetic field between the rotor and field windings. Direct current is used in clutching. This may be varied from a normal amount (to change the speed of the parts or to take a severe working load) down to an idling range during the rest of the press cycle. An effective induction principle locks the rotor to the flywheel. Laminated cores and squirrel cage bars com-



bine eddy current and interlocking induced fields to develop exceptional torque.

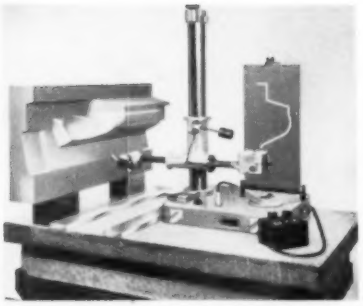
Accutrol is electronic in both power and control. It delivers d-c and a-c alternately to induction windings. Power is supplied through mercury-pool ignitrons. The servosystem, which coordinates analog and digital signals, is versatile in selectivity.

E. W. Bliss Co., Canton, Ohio. **T-7-3**

Nondestructive Inspection Device

Nondestructive sectioning of contoured parts is possible with the OGP countour transcriber, Model 8-18 which makes a permanent record on specially coated glass, of contours of master patterns, models, dies, molds and similar parts.

Contour reproduction on the coated



glass, called a Trace, is a complete and continuous reproduction of a part contour and can be made of both exterior and interior part contours, top and bottom halves of a die, and mating parts. Traces are measured by determining X-Y coordinates on conventional contour projectors, by comparing with a grid, and by comparing to a master outline or reticle.

Designed for rapid, semiautomatic operation, the device handles contours up to 8 in. deep by 18 in. long. Traces on glass may be retained as a permanent record, or the glass may be recoated and used again.

Companion accessory to the contour transcriber is the OGP contour trace measuring viewer. The unit is designed to facilitate measurement and evaluation of contour traces, and is provided with a precision grid glass illuminated from below by a special cold neon tube. Scale readings to 0.0001 inch are possible, using the grid and its associated measuring micrometer.

Optical Gaging Products, Inc., 26 Forbes St., Rochester 11, N. Y. **T-7-4**

Dust Collector

Line of cyclone separator type dust collectors has been converted to radial fans to increase performance on all models. The fans eliminate build-up

of foreign material on the blades in unusual situations where large volumes of dust or where lint and buffing compound must be collected. There is no increase in horsepower requirements.

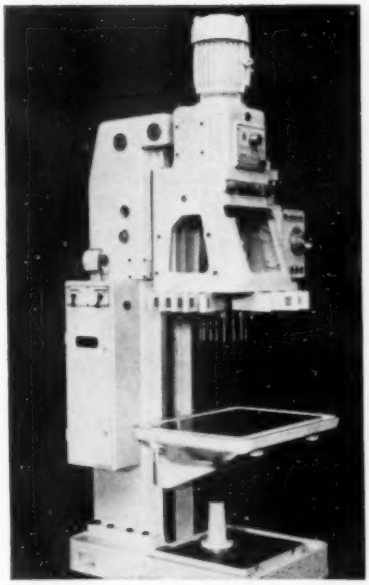
Torit Mfg. Co., 287 Walnut St., St. Paul, Minn. **T-7-5**

USE READER SERVICE CARD ON PAGE 139 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Drilling and Tapping Machines

A multiple spindle drilling and tapping machine, built by L. Burkhardt & Weber K. G., Reutlingen, Germany, can carry a maximum of 12 spindles. Because the spindle carrier is designed in the unit system, it is possible to combine a number of spindle units in any position around an indexing table and obtain semiautomatic drilling and tapping for a variety of operations.

The machine is equipped with a self-

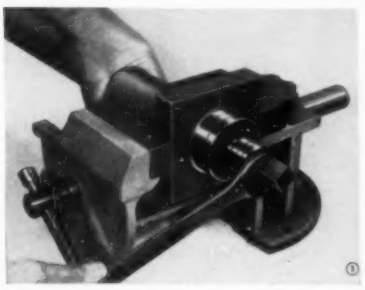


contained hydraulic unit operating the vertical feed of the whole unit. Available are a standard feed, a second feed, a dwell period, a jump power traverse, a step control for deep-hole drilling and a rapid return. The machine also can be equipped with a separate tapping slide, permitting the threading of various pitch threads within the range of the machine.

Distributed by Eric R. Bachmann Co., Inc., 27-11 41st Ave., Long Island City 1, N. Y. **T-7-6**

Spinning and Burnishing Tools

In one operation, this easy-to-use spinning tool expands, sizes and burnishes; it is capable of creating a leak proof



joint with light wall tubing in a few minutes.

Adjustable spacer rings inserted on the mandrel or threaded adjustment collars are provided to regulate the degree of expansion obtained with the tool. Because they minimize excessive forward thrust and over-rolling, they also act as a safety feature. Sizing and

burnishing take place during the "free-spinning" period when the mandrel abuts the adjustable spacer rings or collar on the spinning tool.

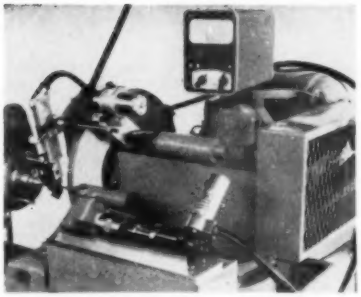
When joining light wall tubing to ferrules, a split die block is used to back up the ferrule preventing distortion while the tube is being expanded, sized and burnished. The tool is designed for use on straight or bent tube elbows having a 2:1 center line bend radius.

The Gustav Wiedeke Co., 1833 Richard St., Dayton 1, Ohio. **T-7-7**

Electronic Attachments for Parts Inspection

A basic console and reading indicator plus other plug-in accessories make up standard attachments which can be used for centerless grinding, strip-chart recording, control of taper, automatic inspection and segregation, electronic tracing, cam forming, etc.

The accessories work on electronic capacitance; therefore, require no air-line connections or extra gages to calibrate air pressure or control air moisture. The system is unaffected by temperature changes. Special electronic design of the Electro-Autosizer, which works within a wide range of tolerances, permits electronic gaging in the machine shop without electrical drift problems.



Quick change-overs and reassemblies are possible for short run manufacturing lots or simple transference of equipment from one type of process to another.

Electro-Autosizing Machine Corp., 180 William St., Closter, N. J. **T-7-8**

Porting Cutters

Cutters for producing the AND - 10050 hydraulic port contours in steels and nonferrous metals are available in 13 standard sizes for hydraulic fittings

used with ⅛ through 2 in. OD tubing. Porting cutters for special applications in both high-speed steel and tungsten carbide tipped also are available.

Eclipse Counterbore Co., 1600 Bonner Ave., Ferndale, Mich. **T-7-9**

Rotary Indexing Unit

A series of universal, automatic rotary indexing machine units is available in table diameters up to 84 in. for general production work. The unit may be utilized for such shop operations as heavy drilling, milling, boring and inspection, and is suitable for programming and for tracing, and is also adaptable for broaching.

This Rotomatic Positioner can accommodate loads up to 50,000 lb because of its extremely rugged construction, with no noticeable deflection and no change

in indexing. The load need not be balanced. The unit can start at full load; it creates no static friction, and there is no strain on the wheel or worm or indexing mechanism.

There is no backlash. Indexing accuracy is guaranteed to within 5 sec of arc on "A" Series, and to within 15 sec on the "B" Series.

A simple change gear system permits varying the index by changing gears. Any number of divisions from 10 to 2500 can be had automatically and manually, the range is infinite. Indexing

can be full automatic, semiautomatic or manual.

An available tape attachment permits the Rotomatic Positioner to be used with either a card or tape system, for controlled operation.

The units are available in horizontal or vertical type in table diameters of 24, 30, 36, 48, 60, 72 and 84 in. A sine base arrangement can be furnished so that the horizontal table can be mounted at any suitable angle from horizontal to vertical.

The Lapointe Machine Tool Co., Hudson, Mass. **T-7-10**

USE READER SERVICE CARD ON PAGE 139 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Counterbores

These interchangeable counterbores consist of three pieces: high-speed cutter, holder and pilot. They have no projection pins, set screws or springs.

Cutters and pilots can be quickly interchanged from one size to another.

The tools, which are used for facing or counterboring holes for sockets or fillister hand cap screws, etc., are available with either straight shank or taper shank holders. Range is almost unlimited. Individual sizes are made in wide selection for any shops use.

Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill. **T-7-11**

Punch Press

This 4-post Multi Max punch press, for short run production and standby tooling, can be quickly converted for automatic stamping by adding any standard roll feed or hitch feed. Accessible for manual or automatic feeding from any or all four sides, it is suitable for assembly line work, or as an integral stamping station in an automatic stamping line. Progressive or transfer fingers can easily be connected to the underdrive for transfer press operations. Underdrive design also affords a close power takeoff for feeding between posts or rotary indexing.

Controls are all electrical for single stroke, continuous running, inching and jogging. Half stroke is possible, where

press will descend to bottom of stroke and dwell for any predetermined period or stop for such operations as induction welding of parts in assembly.

Model shown is 1½ in. stroke, 350 strokes per minute, 10 in. die shut height, 2 in. ram adjustment, bed and ram size of 20 x 24 in., counterbalanced ram, 3 hp motor, and mountings for draw die cushions. Depending on stroke, speeds up to 750 strokes per minute, larger die shut heights, strokes up to 5 in. and bed and ram sizes up to 48 x 48 in. are available. On back geared models, low speeds down to 10 strokes per minute are available.

Diamond Machine Tool Corp., Pico, Calif. **T-7-12**

Milling Cutters

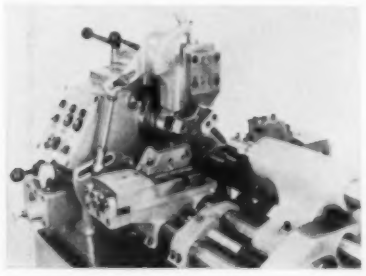
Twelve Series 300 staggered-tooth carbide-tipped side milling cutters range from ⅜ to 1½-in. widths for cutting cast iron, brass and bronze. Design incorporates positive radial and axial rake for free cutting, chip breaking and directing chips toward center of cut assuring smooth score-free surface finish.

The cutters may be used singly or interlocked. They are particularly suitable for cutting thin walled sections or fragile castings; shearing action permits smooth cutting without shock or chatter. Rigid true running bodies with overhanging tips allow regrinding carbide without grinding steel body.

Cutting Tool Div., Brown & Sharpe Mfg. Co., Providence 1, R. I. **T-7-13**

Single Spindle Chucker

A single spindle chucker designated Traub Model AF 130, features an air chuck with over 5-in. capacity. Rigid



cross slides can be moved longitudinally independently. Maximum turning length is 5½ in. The spindle brake is equipped with an electromagnetic clutch and there is ample, easily-accessible chip room provided in the base.

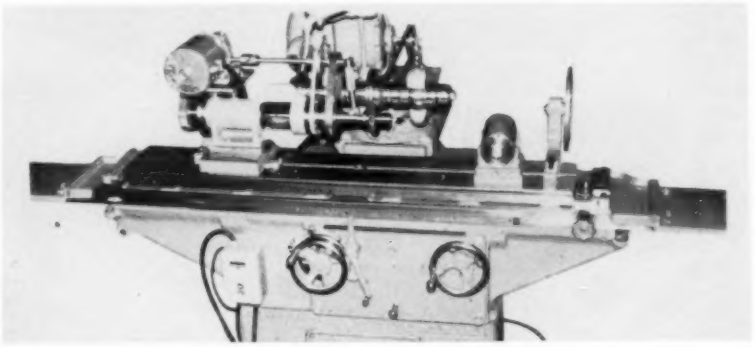
Guthery Machine Tool Corp., 38-31 Crescent St., Long Island City, N. Y. **T-7-14**

Grinding Machine for Throwaway Tools

Designed to grind carbide throwaway tools in various applications, this machine will grind the entire periphery of the throwaway, including the radius, in one operation. The radius is ground perfect tangent with the sides; sides are flat and parallel within 0.0002.

It will grind any shape tool, including squares, triangles, pentagons, diamond shapes and rounds. It will grind any radius from 0.010 in. up. When grinding negative and positive rake tools it will hold a 0.0005 tolerance.

The Harvill Machine Co., 618 E. 10 Mile Rd., Hazel Park, Mich. **T-7-15**



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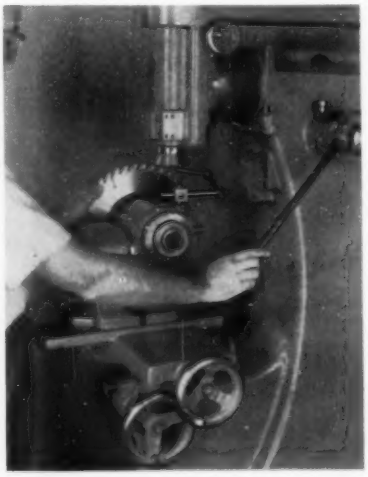
Saw Sharpener

Wood and metalworking plants can sharpen their own carbide tipped and high-speed steel on the ACE grinding machine. It is simple to set up and use and is designed to bring the grinding wheel to the saw to facilitate an accurate grind.

The tool also can be used for sharp-

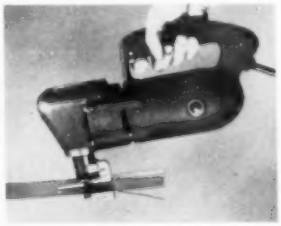


ening other wood cutting tools, as well as face mills, reamers, hobs, spot facers, straight and spiral cutters and all general purpose tools.

Oliver Instrument Co., 1442 E. Maumee St., Adrian, Mich. **T-7-16**

Nibbler

A nibbler that will cut woven wire, wire cloth, and gasket up to 3/16 in. can be used as a portable tool or mounted on a table. It also will cut sheet metal without distortion by cutting out a con-



tinuous ¼ in. strip. Two models are available: one for cutting up to 3/32 wire, and a heavier duty for cutting up to 3/16 wire. Unit operates on 110 v, a-c or d-c.

Modern Mfg. Co., Inc., 680 Davisville Rd., Willow Grove, Pa. **T-7-17**

Lathe Control

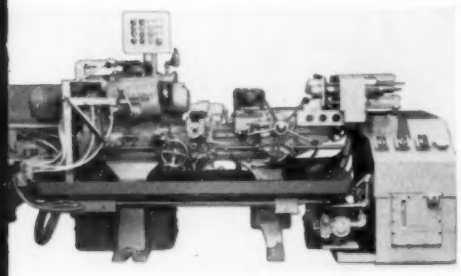
This control unit called the De Silvey Director, performs automatically all turret lathe functions conventionally done by hand. Results are identically finished pieces because the lathe does not vary as in manual operation.

Built-in safety control features protect the turret lathe, tools and workpiece from damage due to inadvertant operation.

Feed rate of the Director ranges from zero to a maximum of 100 ipm and different feed rates can be established for front or back tool.

Headstock spindle speeds, ram, cross

slide functions and all the operations are preselected by a six position drum and a multiswitch assembly called a sequence selector. The six positions of the drum correspond to the six turret positions and each position energizes



certain switches, establishing the functions to be performed at each turret station. No cams are required to obtain any operation.

The turret feed selector is a longitudinal drum with three fully adjustable actuators for each face.

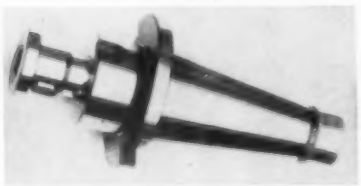
An overload prevention device reverses the tool when the tool slides hit position dead stop and protects the tool and machine from overload when the tool is dull or broken.

The infinitely adjustable index cushion is set to prevent over travel of the turret head caused by the momentum of the heavy tooling.

The De Silvey Corp., Pennsylvania Ave., East Aurora, N. Y. **T-7-18**

Milling Machine Arbor

An unusual type of milling machine arbor developed by Stieber & Nebelmeier, Munich, consists of a base arbor which always remains in the spindle and 3 or 4 interchangeable centering inserts of different diameters. The inserts are guided for their entire length and com-



pletely absorb the axial and radial forces. They are clamped from the front with a long special screw with particularly high clamping power.

The design assures rigid connection between the milling cutter and the arbor of every milling operation in both right and left-hand rotations.

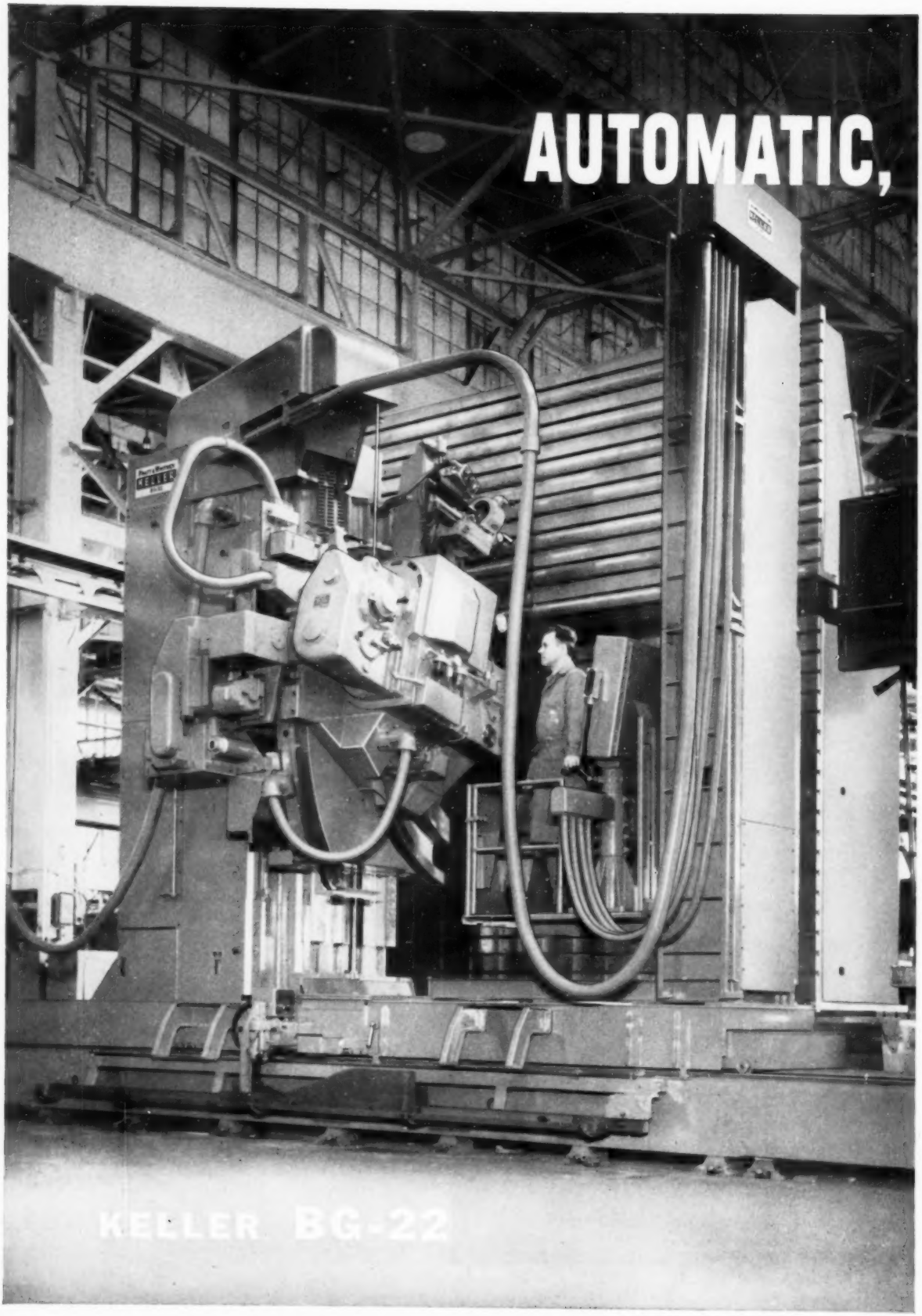
Distributed by A. & H. von Tsurikov, Precision Machinery & Tools, 755 Lake Ave., Rochester 13, N. Y. **T-7-19**

Hot Hardness Tester

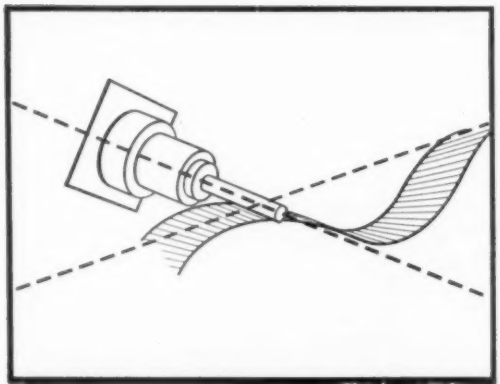
Rockwell hardness properties and characteristics of metals at elevated temperatures can be accurately determined by the Model 6-JR hot hardness tester used in conjunction with a small electric furnace. This device can be utilized to determine the hardness of metals, contained within the shell of a controlled atmosphere gas furnace, at temperatures exceeding 1500 F.

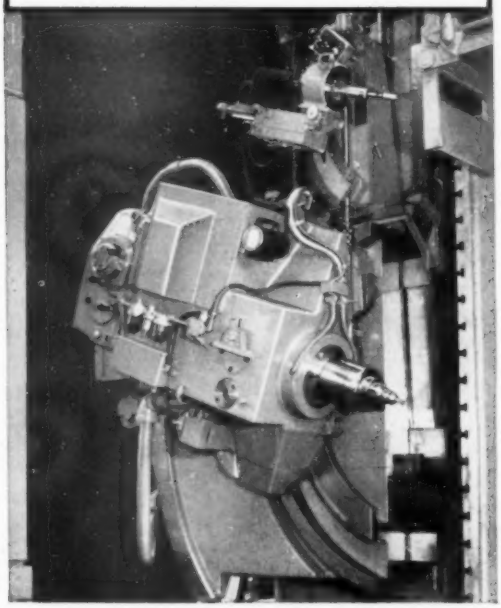
Utilization of the instrument permits accurate measurement of hardness of a sample specimen without cooling it to determine the depth of penetrator impression. The tester's diamond Brale penetrator, for making indentations in the specimen's surface, is contained within the furnace and is heated along with the specimen under test. Hardness tests are conducted in the usual manner.

For temperatures to 1200 F, the furnace operates on 110 v, single-phase power with a maximum input of 1500 watts. For 1500 F operation, the furnace would operate on 80 v, 60 cycle, single-phase current. A variable voltage


AUTOMATIC,
KELLER BG-22

here's a NEW TWIST *in*
TRACER-CONTROLLED MILLING





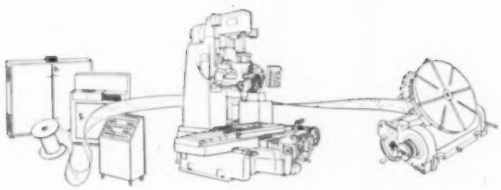
Pratt & Whitney Keller Automatic Tracer-Controlled Milling Machines have long been known throughout industry for their ability to produce complex, irregular 2- and 3-dimensional shapes. They bring outstanding speed, accuracy and economy to the manufacture of dies, molds, prototypes and production parts.

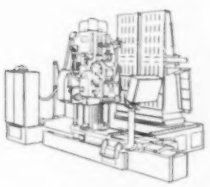
The special machine shown here — a modification of our giant Type BG-22 — adds a "new twist" to the already great versatility of these machines. This special machine can be operated as a standard Keller . . . profile-milling from a 2-dimensional template or duplicating a 3-dimensional full model. In addition, it is equipped with a specially designed milling head that has a range of tilt from 20° above to 20° below the horizontal. With the degree of tilt of the head and cutting tool controlled by a template, this machine will be used to generate "warped surfaces" by profile milling. This type of milling is frequently encountered in the production of aircraft structural components where the outer surfaces of the part must be accurately profiled and, at the same time, correctly twisted or "warped" to conform with the designed contours of the aircraft's surfaces. The development of this special Keller Machine makes it possible to produce these "warped surfaces" by the most direct, accurate and economical method.

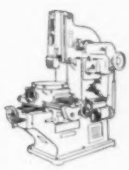
Your own operations may not involve the milling of "warped surfaces." But the example of this special machine demonstrates Pratt & Whitney's experience and engineering know-how in solving special production problems. And — whatever your requirements — for fast, low-cost milling of irregular shapes and complicated curves, there's a P&W Keller Machine just right for every work size with capacities ranging from 36" x 20" to 20 feet by 7 feet.

Write now for complete information . . .

PRATT & WHITNEY COMPANY, INC.,
16 Charter Oak Blvd., West Hartford, Connecticut







NUMERICAL CONTROL . . . JIG BORERS . . . ROTARY TABLES . . . KELLER MACHINES . . . LATHES . . . VERTICAL SHAPERS

PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS

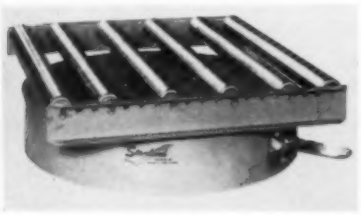
transformer, of sufficient capacity, is used to permit precise control of input voltage.

Six binding posts are provided on the furnace's shunt panel to permit localized control of temperature. By use of resistance-wire shunts, temperature of that portion of the furnace located between any two binding posts may be varied. A constantly circulating supply of water is provided for cooling of the furnace.

Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc. Bridgeport 2, Conn. **T-7-20**

Turntable

This turntable was designed for universal application and, by varying the number of casters used to support the section, offers capacities of 1500, 2500, or 3000 lb. From a minimum height of



6⅛ in. (without roller conveyor section), supports can be provided for correct operating height. Positive type stop can be either foot pedal or hand controlled.

The turntable also can be provided with dust ring for foundry application.

Standard Conveyor Co., North St. Paul 9, Minn. **T-7-21**

Size Gage

Designed for stability, this HYT size gage incorporates nonrotating measuring column spring loaded to avoid backlash. It affords an accuracy of 50 millionths at any measuring point. Readings can be taken on the underside or topside of spacer. Inspection of any machined parts can be checked with this instrument in a matter of seconds. Its light weight permits portability to any location of shop or inspection areas. The lightweight gage has ten-inch

capacity, which can be increased with 3 and 6 in. riser blocks.

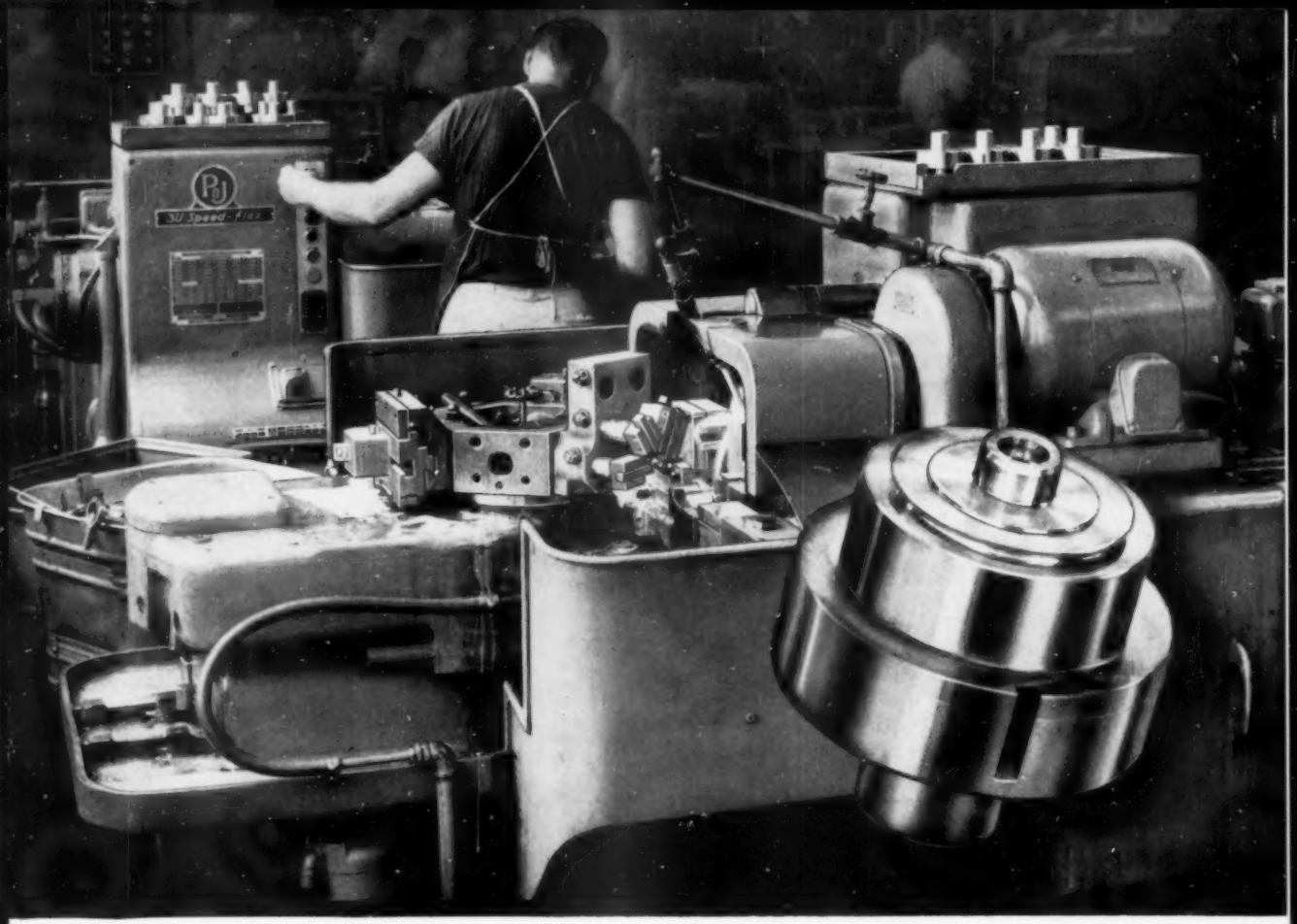
Armour Machine Company at 700 Oak St., Copiague, N. Y. **T-7-22**

Welding Accessory

Any alternating-current welding machine can be converted to direct-current output with one of two portable converters. One unit, Model A2500C, converts a-c to a d-c output of up to 250 amp; the second, Model A4500C, converts to a d-c output of up to 450 amp.

Each converter is a portable, completely self-contained unit and can be placed on top of any a-c welder. Only two connections are required. Auxiliary connections to a 110-volt line are uneccessary.

Manufactured with silicon rectifiers for long life, the convertors have a full

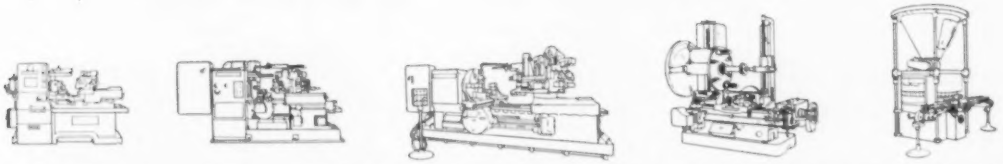


. . . . INCREASE PRODUCTION 45% AND REDUCE MAN-MACHINE HOURS 75%!

American Bosch Arma Corporation, one of the leading producers of automotive, electrical and diesel injection equipment, was using hand turret lathes to machine close-tolerance fuel pump heads. Two of these lathes – each with an operator – were working two 8-hour shifts per day, and a plant-wide survey showed that machining time and costs were too high. Called in to analyze the problem, we recommended two of our P&J 3-U "Speed-Flex" Automatics, with *both* machines to be operated by *one* man on a single 8-hour shift per day.

On the job 18 months, this installation has practically paid for itself in labor savings alone. Now, when the operator receives the workpiece, he chucks it in the first machine, and 12 cuts are completed in a single fully-automatic cycle. He then chucks the part in the second machine, and the remaining 13 cuts are completed. Floor-to-floor time is just 5.5 minutes . . . a 45% reduction over the old method. And 3 machinists have been released for other work.

If your manufacturing operations involve high-speed parts production, a switch from hand machines to P&J Automatics can also bring important benefits to you. Act today. Ask the P&J Representative in your area to analyze your requirements and recommend a production plan that meets your specific needs. If you prefer, write direct to Potter & Johnston Company, Pawtucket, Rhode Island.



AUTOMATIC TURRET LATHES . . . GEAR CUTTERS . . . PACKAGING MACHINES

POTTER & JOHNSTON

SUBSIDIARY OF PRATT & WHITNEY COMPANY, INC.

PRECISION PRODUCTION TOOLING SINCE 1898

60 percent duty cycle industrial rating. They are internally protected against overload and are blower cooled for maximum cooling and quiet operation. A smoothing reactor provides low ripple for arc stability.

A. O. Smith Corp., Welding Products Div., Milwaukee, Wis. **T-7-23**

USE READER SERVICE CARD ON PAGE 139 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Dial Caliper Gages

The Quicktest dial caliper gages measure thickness of sheet metal, pipe walls, walls of cast specimens, profiles, grooves, rounds, threads, also of foils, cardboard, textiles, lumber or rubber. The instruments are available as either external or internal gages. Rapid yet accurate measurements may be made by holding the gage in one hand, leaving the other free to hold the test specimen.

The tool consists of the measuring

mechanism and two protruding shanks as one unit. The lower shank is rigid, while the upper shank is pivoted mobile inside the gage case. It's deflection is transmitted to the pointer. The contact points at the extremities of the shanks make close contact with the test specimen. Four different shapes of contact points are available for various measurements. Caliper gages, with two contact points each, are calibrated in absolute measurements.

Bemax Import-Export Co., Technical Dept. T 5, 612 Street Rd. Southhampton, Pa. **T-7-24**

Recording Device

This efficiency recorded automatically produces a continuous single line on the chart which shows accurately the efficiency of operators, machines and processes.

It keeps an accurate record of productive time as well as the idle or down time. The chart is continuously readable

for every instant in percentage of time over the entire shift, whether it be 8 hours or 31 days.

The unit consists of an aluminum drum driven by a precise constant speed electric motor of electric clock accuracy. The attached chart is inkless, tamper-proof and calibrated for percentages as well as time. The stylus is moved to the bottom of its leadscrew with each new

run. This leadscrew also has a motor of electric clock accuracy and drives the stylus upward only during the periods of productivity.

A Read-Out subbase accessory is available as optional equipment. The left hand six digits show the accumulated number of minutes of "On" or productive time. The four-digit counter on the right shows the number of times the process was started and stopped. Both sets of figure wheels can be reset to zero by the adjacent knobs.

Gorrell & Gorrell, Westwood, N. J. **T-7-25**

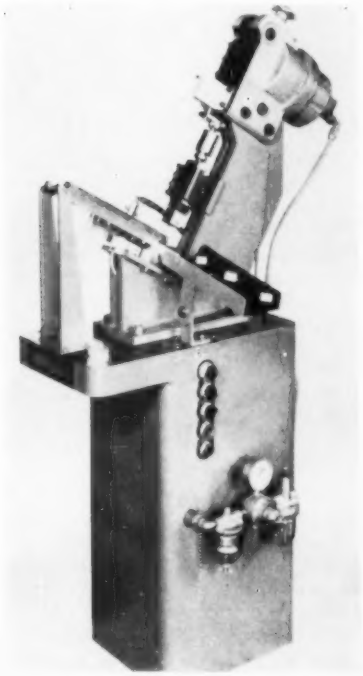
Air Press

Automatic high-speed air marking press, for permanent marking of small pieces, marks two impressions on opposite sides of workpieces simultaneously at the rate of 80 pieces per minute.

Designated Model 504, this compact production marking press incorporates an air operated press head of 10-ton capacity mounted at an angle, and inclined feed chute which brings the workpieces under the ram for automatic marking and automatic air ejection.

The press head operates within a 30 to 100-lb pressure range so that any depth of mark can be achieved by adjusting air pressure to the head. Interchangeable infeed chutes for various parts are readily interchangeable and snap into position.

Marking die holders are mounted in both the ram and in the bed and each can be set up with interchangeable type of logo dies.



The machine circuit is arranged for continuous cycling as long as parts are fed to the machine. Supplementary controls in the circuit make it possible to operate the various components for set-up and test purposes.

The Series 400 machine can be furnished to suit specific requirements. The press itself is normally in the vertical position and can be furnished with gap and reach to suit individual needs. An air operated dial feed table is also available. Machine is furnished complete with all necessary pneumatic and electrical controls, including combination air control unit with filter, regulator and lubricator for direct connection to shop air line.

The Noble & Westbrook Mfg. Co., East Hartford, Conn. **T-7-26**

Short-Run Automatic Machines

Ease of setup is prime feature of a line of Economatics for machining many different parts having a family resemblance. A typical machine drills, bores, reams, taps and chamfers 36 hydraulic valve bodies of different sizes which have holes of different sizes in various locations.

Each machine is assembled from standard building-block components with a control circuit tailored to the family of parts to be machined. Basically, the machine is a double-end trunnion type Economatic with two horizontal hydraulic feed units. Both heads go throught standard cycles of rapid advance, coarse feed (either of two or

more rates), fine feed, positive stop, dwell and automatic reverse. Specific coarse feed rate is picked during setup by a selector switch.

Most of the spindles are grouped in standard "pot" heads but added location flexibility is achieved by also using indexing pot heads. Where different cutting speeds are required by cutting tools of different sizes, sets of change gears are included in that pot.

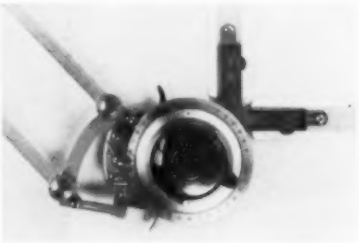
Various feed rates can be achieved simply and with little chance for error during setup. Tool heads are fed hydraulically and feed rates are established by controlling fluid flow. Feed rate is constant, regardless of the tool load.

Buhr Machine Tool Co., Ann Arbor, Mich. **T-7-27**

USE READER SERVICE CARD ON PAGE 139 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Drafting Machines

Parallel motion of the counterweighted and horizontal Isis drafting machine is achieved through use of ball bearing pivoted steel bars. There are no steel bands held in tension—a compensation rod frees the machine's system of arms from loads which otherwise would be imposed by the counterweight. Bearings assure play-free motion of the arms as well as accurate guidance of the drafting head. This construction minimizes wear and insures continuous accuracy.



A prime feature of the equipment is the drafting head (illustrated) which pivots a full 360 deg. Its design is such that the base line can be changed immediately to any reference.

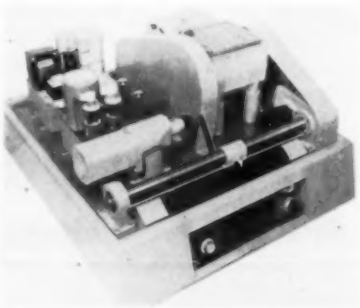
Attachments available for use with the German-made machine include a cross-hatching device.

The AJB Co., Box 1062, York, Pa. **T-7-28**

Electromechanical Control Systems

Simplified control systems of good dynamic response with high accuracy and repeatability are available for applications reqiuring ¼ to 100 hp. The electromechanical system may be used in conjunction with computers or with signal sources sensing linear motion or distance, pressure, temperature, flow and speed, as well as with manual controls. Components include a signal comparator (electrical or mechanical), a power supply converter, the electronic amplifier and the mechanical power amplifier. Output may be either unidirectional or bidirectional.

There are no critical assemblies or adjustments. Component parts are plug-in to facilitate replacement, while test devices may be built in or easily plugged in. High speed response is obtained with a 60 cps servomotor-tachometer which provides system response for inputs up to 8 cps: for requirements beyond this frequency the substitution of a 400 cps servomotor will provide closed loop systems which respond to frequencies up to 25 cps.

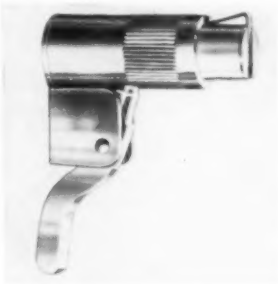


Building block type components permit a variety of control arrangements. Performance of the control system is not effected by environment. In addition, performance is identical one minute or one hour after starting. Normal line voltage changes do not effect system performance.

Seneca Falls Machine Co., Electronics Div., 12 Fyfe Bldg., Seneca Falls, N. Y. **T-7-29**

Die Stop

This automatic die stop for stopping material just prior to the piercing, shearing or blanking operation, can be installed by drilling and reaming a hole in the proper location and then pressing



the stop in position. It is actuated by an adjusting screw located in the top die shoe. Installation time runs about 20 minutes.

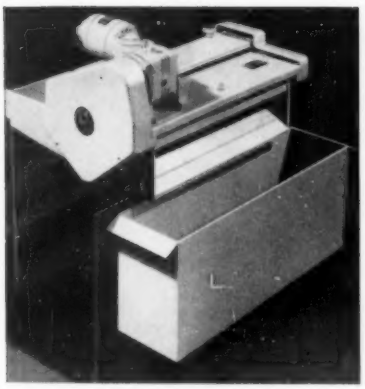
The die stop provides a rigid gaging surface, designed and constructed for long lasting operation.

Keystone Engineering and Mfg. Co., 122 S. W. 16th St., Des Moines, Iowa. **T-7-30**

Coolant Separators

Power-Grip magnetic coolant separators consist of four capacities of 25, 50, 75 and 100 gpm, offer completely automatic coolant cleaning and can be easily installed on grinding, honing, and gear-shaving machines. Ordinarily, they can be placed directly on top of an open coolant tank and required no additional floor space.

A small size unit can clean a relatively high volume of fluid. Coolant leaving the machine passes under the solid, permanently charged magnet revolving drum for direct exposure to the magnetic drum without interference from nonmagnetic insulators. The drum revolves against the flow of coolant to attract magnetic materials out of the flow. Separated material is removed mechanically from the drum as it rotates past the scraper for deposit into a receptacle or sludge pan that is readily



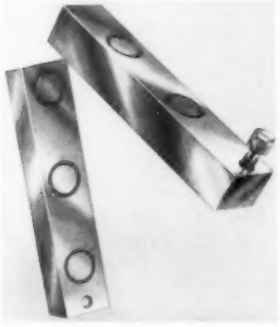
removed for emptying. Usually, no external piping is required.

The smallest unit can be plugged into a conventional 110-volt utility outlet while the three larger sizes use 220 or 440 volt a-c power.

Sundstrand Machine Tool Co., 2531 Eleventh St., Rockford, Ill. **T-7-31**

Magnetic Parallel Bars

Magnetic surfaces of these parallel bars are independent of each other. One side of the bar has three permanent magnetic inserts, and the other side has two similar units. Thus the bar can



be used on both sides simultaneously.

Precision ground, hardened and available in matched sets, these magnetic parallel bars are 1 x ¾ x 5½ in. The 1-in. and the ¾-in. sides have been precision ground to a plus 0.0002 and a minus 0.0000.

Research Engineering and Sales Co., 1014 Longfellow, Royal Oak, Mich. **T-7-32**

Micrometer

The Multi-Mike multipurpose micrometer measures both internal and external metal cuts and grooves and accurately determines groove locations in a matter of seconds.

The tool is 8⅞ in. in length and carries a standard type micrometer head. Two ground and dipped disks, each 0.547 in. in diam and 0.025 in. thick, form the jaws or measuring surfaces of the Multi-Mike. Other sizes can be provided for special applications.

Measuring capability ranges from 0.050 to 1.050 in.; measurement of lands or widths between grooves, ranges from zero to 1.000 in.

Measurement of grooves can be accomplished in holes as small as 0.550 in. in diam. The tool also can be used to measure groove distances from an external reference surface to a probe depth of 5⅜ in. It can be adapted for use as a snap gage in the inspection of internal and external grooves during

high production runs.

Consolidated Aircraft Products, El Segundo, Calif. **T-7-33**

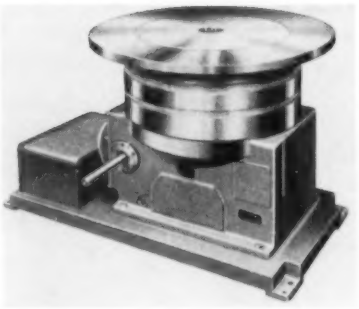
Turret Indexing Chassis

Series M line of standard turret indexing machine chassis are available for use in construction of special automatic machines requiring a rotary inter-

mittent motion.

The chassis offers an optional "umbrella" type tool mounting plate that is vertically actuated during the dwell time of the turret indexing cycle. This circular tool mounting plate is rigidly mounted on a reciprocating center post projecting through the center of the chassis. Its design provides complete accessibility at all points about the turret for tool mounting at any work station. Vertical actuation is entirely mechanical and is provided by means of a lift cam that is coupled to the turret indexing mechanism.

The chassis can also be furnished with a rotating center shaft which permits mounting cams for the horizontal actuation of operational devices from the inside of the turret.



Other features include a rigid stationary center plate for mounting tooling inside of the moving turret: a radial keyed mounting face around the outside of the chassis to fasten standard tool mounting brackets and an extended indexing camshaft for mounting cams to actuate tooling or to initiate electrical controls.

The chassis are offered with turret diameters from 36 to 54 in. and with a choice of 6 to 32 index positions.

Swanson-Erie Corp., 814 E. 8th St., Erie, Pa. **T-7-34**

Expansion Reamer

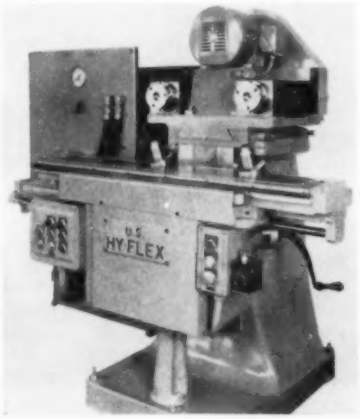
Carbide tipped expansion machine reamers incorporates several new design features. A method of expansion which assures rigidity comparable with that of a solid body reamer. Expansion, to compensate for wear, can be accurately controlled and is uniform throughout the length of the cutting blades.

Cutting element can be replaced quickly and economically. The tools are made in several styles and are available in a wide range of sizes.

The Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio. **T-7-35**

Milling Machine

Single column Hy-Flex milling machine may be equipped with as many as three spindles positioned as required and with any electrically controlled hydraulic table feed cycle. The unit illustrated has two precision spindles and was built to mill accurately located and dimensioned angle slots in an automotive part. Two workpieces are simultaneously loaded into air operated fixtures mounted on the machine table. Each



spindle machines one slot as the table feeds longitudinally. On its return, the fixtures unclamp automatically.

Two precision spindles are bolted to a common slide, equipped with adjustable gib, Acme screw, and micrometer dial for accurate in-and-out adjustment. Idler pulleys permit changing the position of the spindles for specific job requirements and still furnish proper belt tension. An oversized knee provides maximum support for special length or width tables.

Vertical slides, as well as a horizontal slide and selective spindle speeds up to 12,000 rpm are available.

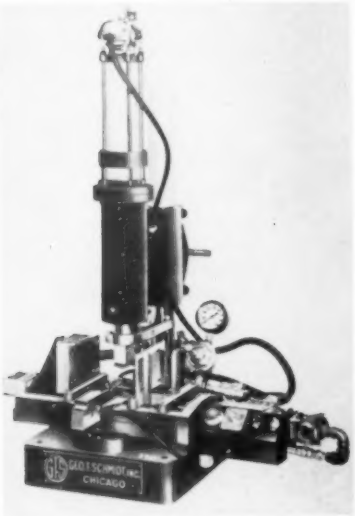
U. S. Burke Machine Tool Div., Brotherton Rd., Cincinnati 27, Ohio. **T-7-36**

USE READER SERVICE CARD ON PAGE 139 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Name Plate Marker

Basic unit of this automatic name plate marker is the Pneumark 10T impact bench press. The adjustable stacker feed accomodates rectangular plates 1 to 2 in. wide and 2 to 4 in. long x 0.014 to 0.024 in. thick. Production rates range from 3000 to 3600 per hour.

It is fully automatic in operation; an operator merely loads the feed



stacker and unloads the marked plates from the discharge stacker.

The feed can be used with a serial numbering head for consecutive numbering. Plates are automatically stacked in numerical sequence after marking. By using drawer style upper chase, all details except serial number can be stamped in blank pads on plates.

Geo. T. Schmidt, Inc., 4100 Ravenswood Ave., Chicago 13, Ill. **T-7-37**

Measure in Millionths

Now you can see ten millionths of an inch . . . Easily estimate five millionths . . . with Ames Portable Transistorized Comparator.

An amazingly sensitive comparator, Ames Porta-Check now makes it possible to get accurate measurements—*in millionths of an inch*—anywhere in the plant. Use it on the production line; at quality control check points; in the tool room—wherever you need it!

Porta-Check converts minute dimensional variations to voltage changes and amplifies them so they can be read easily and accurately. The meter dial—shown in actual size—can be used as either a "tenths" scale or a "thousandths" scale by simply setting the front panel rotary switch.

As a "tenths" scale it is graduated directly to *ten millionths*. With the generous spacing between graduations it is easy to estimate *five millionths*. Total range on this scale is .0006".

As a "thousandths" scale it is graduated directly to .0001", making it simple to estimate "half tenths". Total range on this scale is .006".

The low friction pick-up head is unaffected by environmental conditions and uses no mechanical magnifications. In fact, the pick-up tip, which is the only moving part in the pick-up head is supported by a blade fulcrum bearing that is frictionless and free from bind, play or wear.

Check these exclusive Porta-Check features

1. Completely Transistorized (no vacuum tubes)
2. Low cost, long life batteries provide power
3. Lightweight, portable—use it anywhere in the plant
4. Accurate, Sensitive, Rugged
5. Simultaneous zero setting for both scales
6. Simultaneous magnification setting for both scales
7. Two scales: "Tenth" scale graduated to *ten millionths*

   "Thousandths" scale graduated to .0001"

The new Ames Porta-Check is truly the most accurate portable comparator available today—and it's low in cost! See your local Ames representative or write directly to the factory for complete details.

Representatives in Principal Cities

B.C. AMES CO.

30 Ames Street, Waltham 54, Mass.

Canadian Representative—J. B. Morrison Machinery Co., Ltd., 45 Ovide Parkway, Toronto

MANUFACTURERS OF MICROMETER DIAL INDICATORS AND GAUGES

MEN at WORK

Morse Chain Co., subsidiary of Borg-Warner Corp. has announced election of **Robert O. Bass** to the offices of president and general manager. Formerly executive vice-president and assistant general manager, he succeeds **Stanley J. Roush** who relinquished his duties in Ithaca to devote more time to responsibilities as a group vice-president in the Borg-Warner central office.

Robert J. Sloan was elected president of Crouse-Hinds Co. to succeed **J. R. Tuttle** who continues as chairman of the board of directors. Mr. Sloan, who has been with the company for the past 35 years, has been executive vice-president since 1956.

C. J. Baumgart, president of Screw Machine Engineering Co., was elected president of the National Screw Machine Products Assn. at the annual meeting in Chicago.

E. F. Borisch became president of American Gear Manufacturers Assn. at the recent annual meeting. He is executive vice-president of Milwaukee Gear Co.

L. H. Durdin was recently elected president of American Foundrymen's Society at the annual meeting in Cleveland. He is president of the Dixie Bronze Co.

Election of **L. G. Porter** as president and general manager of the Long Mfg. Div. of Borg-Warner Corp. and Long Mfg. Co. Ltd. of Canada, a subsidiary, has been announced. Mr. Porter, who also is executive vice-president of Borg-Warner, succeeds **T. J. Ault,** who resigned as president of Long, to become president of Saco-Lowell Shops.

Harry H. Whittingham now becomes assistant general manager of the Long Mfg. Div. in addition to continuing as vice-president.

At Norton Co.'s Abrasive Div., **Robert G. Van Keuren** was named to head the newly created product engineering department as manager of product engineering. **Frank G. Gustafson** was made supervisor of sales engineering. Both men are members of ASTE's Worcester chapter.

An accelerated research and development program at Midwestern Instruments, Inc. has brought appointment of **William H. Duerig** to vice-president in charge of research and engineering. Dr. Duerig joins Midwestern from Electro-Mechanical Research, Inc. where he managed the Engineering Research and Development Div.

Frank J. Fields has been appointed president of Hufford Machine Tool Co. He formerly was works manager of the company. Prior to joining Hufford last year, he was executive vice-president and general manager of Sidney Machine Tool Co.

Directors of Cincinnati Milling and Grinding Machines Inc. recently elected **Philip O. Geier, Jr.** and **W. Kent Mathias** vice-presidents. Mr. Geier, who also was elected a director, has been associated with the parent firm, The Cincinnati Milling Machine Co., since 1939 and is manager of their Products Div. Mr. Mathias, who joined the parent company in 1937, is manager of their Grinding Machine Div.

At Buhr Machine Tool Co., **Michael Zajac** was named to fill the newly created post of vice-president in charge of engineering. He has been the company's chief engineer for the past two and a half years.

Appointment of **John A. Backstrom** as general manager was recently announced by the Palmer Tool and Forging Co. Mr. Backstrom was previously works manager of The Enterprise Co., subsidiary of Wm. K. Stamets Co.

W. A. Meddick is new president and general manager of The Elwell-Parker Electric Co. succeeding the late Sheldon K. Towson. He was previously sales manager and vice-president of the company.

At the same time, members of the board of directors elected **Sheldon K. Towson, Jr.** as vice-president and assistant general manager. He has been assistant to the president since 1956.

Dan W. Burns, who was previously vice-president and general manager of The Hufford Corp., subsidiary of The Siegler Corp., is now president of the company succeeding Merrill L. Bengtson.

Robert F. Gladfelter, former vice-president of sales, is new president of Detroit Power Screwdriver Co. succeeding Roy W. Bailey a member of ASTE's Detroit chapter, who retired.

Warren C. Olson is new president of Besly-Welles Corp. succeeding Edward K. Welles who became chairman of the board and chief executive officer. Mr. Olson was executive vice president.

Perry T. Egbert was elected chairman and **William S. Morris** president of Alco Products, Inc. Prior to this election, Mr. Egbert was president of the Company, and Mr. Morris served as executive vice-president.

Oscar Ahlers has been named general manager of The Sheffield Corp. and will supervise all sales, product divisions and field service manufacturing facilities, in addition to his previous responsibilities. He has been associated with Sheffield for more than 32 years.

Edward C. Helmke is now chief engineer of Gisholt Co. A veteran of 23 years with the company, he was formerly assistant chief engineer. Mr. Helmke is a member and past chairman of ASTE's Madison chapter.

The board of directors of The Timken Roller Bearing Co. has elected Herbert E. Markley vice-president of the company. He has been assistant to the president, a post now filled by Richard L. Frederick.

Three promotions have been announced by The Hydraulic Press Mfg. Co., a division of Koehring Co. **E. L. Oehling** moved from general sales manager to vice-president-sales. **T. G. Bishop,** formerly manager of plastics machinery division, was named product market manager. **W. G. Kriner,** manager of dealer sales replaces Mr. Bishop as head of the plastics division.

Charles E. Nelson has been elected vice-president of American Foundrymen's Society with new President Durdin. Mr. Nelson is technical director of Magnesium Div. of Dow Chemical Co.

New officers elected with President Baumgart by National Screw Machine Products Assn. include **Leonard R. Schaffer** as vice-president and Roland G. Herker as treasurer. Mr. Schaffer is president of Mechanical Art Works, Inc., and Mr. Herker is vice-president and treasurer of Herker Screw Products, Inc.

Promotions involving **Leonard M. Kulze** and **Joseph A. Harinek** have been announced by Associated Spring Corp.'s Gibson Div. Mr. Kulze is now factory manager while Mr. Harinek was named to succeed him in his former post of chief engineer.

Officers elected to serve with new AGMA President Borisch include **John L. Buehler** as vice-president, gear products division; **Folke Richardz** as vice-president, technical division; and **J. F. Murray,** treasurer. Mr. Buehler is president of Indiana Gear Works, Inc. Mr. Richardz is consulting specialist, gearing products at Westinghouse Electric Corp. while Mr. Murray is president of Winsmith, Inc.

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

A-7-158—Drills—*Ace Drill.* The latest Ace Drill catalog and current net price schedule are now available. (Page 158)

A-7-182-2—Carbide Drill Bushing—*Acme Industrial Co.* Price information and location of nearest distributor are available on all standard bushings. (Page 182)

A-7-151—Vernier Caliper—*Alina Corp.* Catalog describes Etalon No. 17 precision vernier caliper and complete line of precision measuring instruments. (Page 151)

A-7-114—Die Steel—*Allegheny Ludlum.* Four-page booklet describes handling and shop treatments of Sagamore die steel. (Page 114)

A-7-2—Brass—*American Brass Co.* Detailed information on Formbrite supergrain drawing brass by Anaconda is available. (Page 2)

A-7-116—Machine Tools—*American-Edelstaal, Unimat Div.* Illustrated literature and price list available on Unimat multipurpose tool. (Page 116)

A-7-8—Radial Drill—*The American Tool Works Co.* Bulletin No. 328 gives specifications of exclusive American Hole Wizard radial drill. (Page 8)

A-7-144—Band Saw—*Armstrong-Blum Mfg. Co.* New catalog on Marvel metal-cutting saws. (Page 144)

A-7-138—Machine Tools—*Baker Brothers, Inc.* Automation data available on Baker special and Baker standard machine. (Page 138)

A-7-194—Collets—*Balas Collet Mfg. Co.* Catalog and price list describe Balas master collets. (Page 194)

A-7-40—Feeding Devices—*The Bellows Co.* Typical case history stories using air units described in Bulletin DP-110 RT. (Page 40)

A-7-160—Grinding Machines—*The Blanchard Machine Co.* Free copies of "Work done on the Blanchard" and "The Art of Blanchard Surface Grinding" available. (Page 160)

A-7-193-2—Fixture Components—*Carr Lane Mfg. Co.* Catalog No. 5 describes many types of fixture jig and fixture parts. (Page 193)

A-7-191—Abrasive Tool—*Chicago Pneumatic Tool Co.* CP Hicycle tools described in Bulletin No. 900. (Page 191)

A-7-148—Optical Grinder—*Cleveland Grinding Machine Co.* Free brochure discusses the capabilities of visual grind surface grinder. (Page 148)

A-7-149—Tool and Die Making—*Cleveland Tool and Die Co.* Brochure describes facilities of Cleveland Tool and Die Co. (Page 149)

A-7-156—Carbide Gages—*Arthur A. Crafts Co., Inc.* Free gage catalog describes plug, ring and gagematic gages. (Page 156)

A-7-30—Hydraulic Press—*Denison Engineering Div., American Brake Shoe Co.* The line of Denison Multipress presses described in Catalog 120-D. (Page 30)

A-7-170-1—Toggle Clamps—*Detroit Stamping Co.* Forty-page De-Sta-Co catalog shows complete line of toggle clamps. (Page 170)

A-7-146—Plastic Steel—*Devcon Corp.* Free catalog shows many uses for plastic steel. (Page 146)

A-7-29—Boring Tools—*DeVlieg Microbore Div., DeVlieg Machine Co.* Catalog No. 58 describes microbore precision boring tools and applications. (Page 29)

A-7-16—Hydraulic Valves—*Dukes Co., Inc.* Complete new catalog of Dukes' hydraulic equipment available. (Page 16)

A-7-39—Contour Projector—*Apparatus and Optical Div., Eastman Kodak Co.* Free booklet "Kodak Contour Projectors" shows optical gaging uses. (Page 39)

A-7-121—Photographic Equipment—*Eastman Kodak Co.* Illustrated booklet "High-Speed Motion Pictures at the Service of the Engineer" details how high-speed camera and films can help solve design problems. (Page 121)

A-7-142—Cutting Tools—*Eclipse Counterbore Co.* Catalog 51 shows high-speed steel and tungsten carbide tipped cutters. (Page 142)

A-7-27—Face Gears—*The Fellows Gear Shaper Co.* Information on design and cutting of face gears is available. (Page 27)

A-7-117-1—Microscopes—*The Gaertner Scientific Corp.* Bulletin 147-56 shows applications, models and specifications of various microscopes. (Page 117)

A-7-22—Portable Tools—*Gardner-Denver Co.* Free bulletins give complete information on portable screwdrivers, angle nut setters and drills. (Page 22)

A-7-123—Milling Machines—*Greaves Machine Tool Co.* Free comparison chart compares Greaves mills with other makes. (Page 123)

A-7-161—Cutting Tools—*Greenfield Tap & Die.* Free carbide catalog-handbook gives important tips on availability, selection, care and operation of carbide tools. (Pages 161-162)

A-7-171—Automatic Bar Machines—*Greenlee Bros. & Co.* Catalog A-405 gives specifications on air feed automatic bar machines. (Page 171)

A-7-166-2—Collet Chucks—*Hall Mfg. Co.* Illustrated catalog and price list describe various sizes of Hall collet chucks. (Page 166)

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THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

A-7-145—Threading Tools—*Hanson-Whitney Co., Div. of Whitney Chain Co.* Literature available on complete line of Hanson threading tools. (Page 145)

A-7-157-2—Centers—*Ideal Industries, Inc.* Complete catalog data and specifications available on Ideal gold band live centers. (Page 157)

A-7-131—Coolant Filtering System—*Industrial Filtration Co.* Delpark dual manifold vacuum filter-matic filter described in new bulletin. (Page 131)

A-7-147—Wear Plates—*Lamina Dies and Tools, Inc.* Complete information available on Lamina bronze-plated wear plates. (Page 147)

A-7-182-1—Collets—*Louis Levin & Son, Inc.* Catalog M lists collets as well as full line of instrument lathes and accessories. (Page 182)

A-7-188—Cutting Tools—*Metal Carbides Corp.* Seventy-six page catalog No. 57-G lists standard Talide tools including applications. (Page 188)

A-7-15—Cutting Tools—*Metallurgical Products Dept. of General Electric Co.* Information available on Carboloy extra-performance and general-purpose carbides or nonferrous material carbides. (Pages 14-15)

A-7-175-2—Carbide Jig Bushings—*W. F. Meyers Co., Inc.* Information and price list on Meyco carbide inserted drill jig bushings available in Catalog No. 42. (Page 175)

A-7-37—Hydraulic Cylinders—*Miller Fluid Power Div. of Flick-Reedy Corp.* Bulletin JH-104N gives complete data plus helpful charts for design using hydraulic cylinders. (Page 37)

A-7-11—Subland Drills—*Mohawk Tools, Inc.* Free brochure entitled "Why Use Two . . . When One Will Do" gives ideas and suggestions on drills. (Page 11)

A-7-12—Milling Machines—*The Robert E. Morris Co.* Details on the complete Nichols line in catalog "The Millers That Use Their Heads." (Page 12)

A-7-178-3—Jig and Fixture Components—*Northwestern Tools, Inc.* New 16-page catalog includes tracing templates on jig and fixture components. (Page 178)

A-7-135—Cleaning Compounds—*Oakite Products, Inc.* Sixteen-page, illustrated booklet describes cleaning and preparing metal in aircraft production. (Page 135)

A-7-9—Induction Heating—*The Ohio Crankshaft Co.* Free booklet "Typical Results of TOCCO Induction Heating for Forging and Forming." (Page 9)

A-7-193-1 — Microscopes — *Opto-Metric Tools, Inc.* Details of Leitz new simplex toolmaker's microscope in Catalog 81/155. (Page 193)

A-7-186—Power Brushing—*The Osborn Mfg. Co.* Free 20-page Brushamatic booklet shows power brushes use. (Page 186)

A-7-187-3—Forming Tools—*Parkwood Laminates, Inc.* Technical bulletin and literature describes features of Hi-den tool material. (Page 187)

A-7-157-1—Dial Indicators—*Petz-Emery Inc.* Complete line of dial indicators described in new catalog DD. (Page 157)

A-7-122—Clutches—*Rockford Clutch Div. Borg-Warner Corp.* Typical installations of Rockford clutches and power take-offs with diagrams. (Page 122)

A-7-133—Machine Components—*Seibert & Sons, Inc.* Free data in bulletin describing Seibert holding and driving tools. (Page 133)

A-7-166-4—Countersinks—*Severance Tool Industries, Inc.* Information and prices on Severance tools available in new catalog. (Page 166)

A-7-159—Chucks—*Speedgrip Chuck Div. of Ernest, Holdeman & Collet, Inc.* Bulletin No. 53 gives full description and technical details on Speedgrip "Cylinder Chucks." (Page 159)

A-7-168—Ground Shafting—*Thomson Industries, Inc.* Free literature describes advantages of 60 case hardened and ground cylindrical parts. (Page 168)

A-7-28—Drill Heads—*United States Drill Head Co.* Catalog AD-57 shows adjustable and fixed center multiple drilling heads. (Page 28)

A-7-154—Plug Gages—*The Van Keuren Co.* 258-page Van Keuren catalog and Handbook No. 36 contain complete details including technical and engineering information on measuring problems and methods. (Page 154)

A-7-178-2—Radial Drill—*Veet Industries.* Free brochure discusses 16 points about the Veet 3-foot radial drill. (Page 178)

A-7-36—Tooling Specialties—*Vlier Engineering Corp.* New catalog shows standard Vlier tooling accessories. (Page 36)

A-7-175—Abrasive Cutoff Machines—*Wallace Supplies Mfg. Co.* Free 44-page book on Wallace machines available on request. (Page 175)

A-7-150—Indicator Gage—*Waters Mfg. Inc.* Bulletin, price list available on 38 models of Waters torque watch gages. (Page 150)

A-7-120—Spindles—*Whitnon Mfg. Co.* Literature describes Whitnon high frequency electric spindles. (Page 120)

A-7-117-2—Tube Mills—*The Yoder Co.* Fully illustrated 88-page Yoder tube mill book describes advantages of operating Yoder mills. (Page 117)

A-7-130—Collet Fixtures—*Zagar, Inc.* Data Sheets "E-7" give information on various Zagar holding fixtures. (Page 130)

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FIELD notes

A coded and classified file of more than 15,000 patents on welding is housed in the A. F. Davis Welding Library at The Ohio State University in Columbus. The file, which is currently being completed for 1957, is open gratis to anyone to use with the assistance of the librarian. For a fee the staff will search the files and forward patent numbers. The library contains approximately 6,000 volumes on welding as well as award designs from many mechanical and structural design competitions sponsored by The James F. Lincoln Arc Welding Foundation. Ohio State Engineering Experiment Station Bulletin 140 covers the classification system.

new activities

With the establishment of a new Digital Devices Dept. that will apply semiconductor techniques to data acquisition and reduction in analog and digital systems, Gulton Industries, Inc. has entered the computor field. First phase of activities for the new department includes design and manufacture of transistorized instrumentation for commercial and experimental use.

V V V

Establishment of a Gear Service Dept. has been announced by Illinois Tool Works. It will function in cooperation with the Machine and Instrument Div. Services include prototype gear and product manufacturing, gear inspection and analysis, design and product engineering service, and a gear training program.

V V V

With a complete new installation that includes machines for cam layout, shaping and inspection, the American Cam Co., Inc., is equipped and staffed to handle all phases of Swiss cam design and production.

V V V

A fully equipped test laboratory has been placed in service by Hamilton Div. of Baldwin-Lima-Hamilton Corp. at its Hamilton, Ohio, plant for research and development work in the field of parts compacting. Tests will involve compacting of such materials as metal powders, abrasives, carbides, cermets, ferrites, plastics, nuclear fuels and solid fuels for rockets and missiles. The lab will provide data for evaluating quality, tolerances, production speed and overall feasibility of producing any part by compacting.

V V V

A reclamation service which reclaims waste or used diamond is announced by Abrasives Div. of Elgin National Watch Co. The service assures accurate assay of sludge for manufacturers using diamond compounds and powders for lapping or diamond wheels for grinding. Elgin offers either to assay the entire sludge and buy it outright, or clean, regrade and return the diamond content. The company also offers a compounding service for reclaimed material after cleaning and grading.

V V V

A contract manufacturing service for performing gun drilling and gun reaming operations on high-production, small-lot and experimental parts has been instituted by Star Cutter Co. The new gun drilling production department is an outgrowth of a production research laboratory facility. It expanded over the past three years, during which the company has developed a complete line of gun drilling tools.

V V V

Wai-Met Alloys Co. has entered the vacuum melted alloy field as result of an exclusive sales agreement between Wai-Met and Allvac Metals Co. of Monroe, N.C. for sale of vacuum melted alloys to the casting industry.

expansions

Plans to more than double the Portland, Ore. manufacturing operation are under way by Atkins Saw Div. of Borg-Warner Corp. A building has been leased at 337 N.E. 10th Ave. to provide approximately two and a half times the space presently available, and the company will add about $75,000 worth of new equipment and close to $100,000 additional stock.

In a major expansion move, Narda Ultrasonics Corp. has acquired Alcar Instruments Inc. which specializes in ultrasonics research and development and is a supplier of custom-built systems and high-powered ultrasonic equipment and special devices. Alcar will be operated as an independent subsidiary of Narda Ultrasonics with production and research activities continued at its plant in Little Ferry under the same management as formerly. Sales offices will be moved to Narda's headquarters.

V V V

A two-story factory and office building adjacent to existing facilities at 2222 S. Calumet Ave. in Chicago was recently completed for Supreme Products Corp., wholly owned subsidiary of A•S•R Products Corp. The new structure provides an additional 43,000 sq ft of working space and will house additional equipment and personnel required for expanded operations.

trade associations

Two booklets on apprenticeship are made available from National Tool & Die Manufacturers Assn at 907 Public Square Bldg., Cleveland. "Earn While You Learn" is designed for the boy still trying to decide his future and tells of advantages of the tool and die making trade. "Apprenticeship Standards for Tool and Die Makers" gives recommendations of NTDMA for training for that trade. The standards have been registered and approved by the U.S. Bureau of Apprenticeship and Training.

new facilities

Establishment of a new Western Branch in Los Angeles has been announced by Pesco Products Div. of Borg-Warner Corp. The branch, with full scale engineering and manufacturing facilities, will be concerned with design development and production of special purpose a-c generating equipment. It also will function as sales and service representative for the complete line of Pesco aircraft and industrial products in 11 western states.

V V V

Portage Tool Co. has purchased a two-acre site in Centex Industrial Park 18 miles from Chicago in Elk Grove Village. Plans call for a structure with 12,000-sq ft of manufacturing space which is scheduled for completion sometime in 1960.

V V V

Potter & Brumfield, Inc., subsidiary of American Machine & Foundry Co., has plans underway for a manufactur-

ing facility in Canada. The leased plant, at 135 Oxford St., in Guelph, Ontario, comprises more than 10,000 sq ft of manufacturing and warehousing space. It will be known as Potter & Brumfield Canada Ltd., and will be a wholly owned subsidiary of the Princeton, Ind., firm. Manufacturing is scheduled to start about August 1.

v v v

Greer Hydraulics, Inc. has opened a new sales office at 1059 Tranquilla Dr. in Dallas, Texas.

corporate changes

Controlling interest in Hi-Lo Mfg. Co. has been acquired by Lovejoy Flexible Coupling Co. Hi-Lo formerly was Equipment Engineering Co. The acquisition augments the present Lovejoy variable speed pulley line. Hi-Lo will continue operations in Minneapolis with sales headquarters in Chicago.

v v v

Roll Formed Products Co. has purchased FlexAngle Corp. Both the corporate and trade name of the acquired company will be retained, and products will continue to be distributed nationally through present FlexAngle distributors.

v v v

Shareholders of Metal Forming Corp. have approved the proposal to exchange assets of their corporation for shares of capital stock of Vanadium-Alloys Steel Corp. The agreement covering the plan previously had been approved by directors of both companies. After the merger is completed the Indiana company will be identified as Metal Forming Corp., Div. of Vanadium-Alloys Steel Co. Present personnel will be retained.

v v v

Handy & Harman has acquired Posen & Kline Tube Co., Inc., as a further step in the company's move toward diversification and expansion. The newly acquired company will operate as a wholly owned subsidiary. Management will continue at Norristown under supervision of the present owners with Stanley G. Posen as president and Robert H. Kline as vice-president.

v v v

Purchase of Renco-Toledo, Inc. has been revealed by Cleveland Pneumatic Industries. No organizational change or facility relocation is anticipated at present, and all items of the Renco line will continue to be marketed under the established trademark of "Renco-Aire."

v v v

Real estate, including land, buildings and foundry equipment, of The Prescott Co. has been purchased by Giddings & Lewis Machine Tool Co. for an undisclosed price. The foundry is capable of producing gray iron castings up to 70,000 lb. Prescott will continue manufacture of sawmill machinery and diesel engines as well as contract work in the machine shop. Plant area to be used in this manufacturing will be leased from Giddings & Lewis.

new company

Formation of the H. F. Wood Co. has been announced by its president, Harold F. Wood, Jr. The company, which will be engaged in industrial marketing, has headquarters at 414 Kittanning Pike, Pittsburgh, Pa.

product transfers

Manufacture and sales of the Glenny adjustable expansion broach, formerly sold by East Shore Machine Co., has been taken over by Baj Tool Co. in Cleveland.

v v v

Renamed the Hartman Booster, the former Oster portable lift now is being manufactured by Hartman Metal Fabricators, Inc. The device formerly was manufactured by Oster Mfg. Co.

v v v

The hydraulic pump and fluid motor business of the Gerotor-May Co. is becoming a part of the Hydraulics Div.

of the Brown & Sharpe Mfg. Co. in a major step toward full scale development of the division. Actual acquisition of the business was made by the Double A Products Co., a group of B&S's Hydraulics Div.

name changes

Name of the company formerly known as Allen J. Smith and Associates has been changed to the AJB Co. The firm distributes the Isis drafting machine in this country.

V V V

Growth of Engelberg Huller Co., Inc.'s abrasive belt grinder division which in 1957 accounted for about 80 percent of total company sales, has resulted in a change of company name to Engelberg, Inc. "Huller" part of the original name referred to the company's Rice and Coffee Machinery Div. which manufactures rice and coffee hullers.

anniversaries

Brown & Sharpe is this year celebrating a century and a quarter of activity in the precision grinding field. From early manufacture of clocks and precision instruments to today's supersonic age, Brown & Sharpe has had a major role in raising standards of accuracy and efficiency of production.

V V V

This year marks the 40th anniversary of Bausch & Lomb Optical Co.'s successful manufacture of high grade optical glass for scientific, professional and industrial uses. During these years the operations have grown from small experiments by William Bausch to an industry using about 750 tons of pure sand per year.

moves

The End Mill Div. of Eclipse Counterbore Co. has moved from North Branch, N.J. to the main Eclipse plant in Ferndale, Mich.

V V V

Vac-U-Lift Co., a subsidiary of Hufford Div. of The Siegler Corp., has moved into a new 18,000-sq ft plant at Salem, Ill. The structure is designed to allow for future expansion without conflict to existing operations.

V V V

Administrative, engineering and research-development staffs of Coleman Engineering Co., Inc. have been consolidated in a new facility at Torrance, Calif. They formerly were housed in five buildings in Culver City.

technical Shorts

Hydro-Mechanical Drive Developed

A HYDROMECHANICAL infinitely variable speed drive, having constant horsepower range of 13.5 to 1 may shortly provide solution to the power transmission problems confronting engineers, who need a wide-range, constant-hp infinitely variable speed control study heretofore has been concentrated largely on frictional, electrical and electronic methods—the practical constant horsepower ranges of which seldom exceeded three or four to one.

While not yet ready for commercial application the hydroelectrical drive has been designed, built and successfully tested at The Bullard Co.

Coupled to a vertical turret lathe, the 40 hp prototype provides a smooth transition of output speeds from 0 to 1800 rpm. In one test, face of a large diameter steel disk-like part was machined from perimeter to center with a constant feet-per-minute cutting speed and at a constant horsepower. Result of the smoothness of speed changes was dramatically demonstrated by suddenly reducing the speed to 0 with a carbide tool buried in a cut and immediately increasing the speed to 300 fpm with the tool still buried within the cut. There was no damage to the carbide tool or work. Extended overload tests up to 75 hp showed no damage to the transmission. From the no-load condition to full load, even with instant loading, there is no perceptible drop in rpm.

The principle of operation of the new drive includes the combining of planetary differentials with two small size positive displacement hydraulic units. The heart of the drive comprises two planetary differentials that are so interconnected that during the operation of one, the other is preconditioned to take over where the first left off, and vice-versa. While a drive can be built employing this nucleus, the 40 hp prototype employs two additional planetary differentials which are so connected to the heart of the drive that three separate but continuous ranges of speed are transmitted to the output shaft.

Clutches Operate Sequentially

Hydraulically operated clutches in the drive operate sequentially in various combinations to transfer flow of power between all of the planetary differentials. Design of the gearing within the drive is such that infinitely adjustable speeds of the output shaft are produced with no noticeable output speed drop or even a distinct plateau throughout the entire range of speed from 0 to 1800 rpm.

The sequential shifting of the clutches is controlled by a system that insures the engagement of a power transferring clutch prior to the disengagement of the clutch from which the power is transferred. Furthermore all clutch shifting operations take place at synchronous speed and the engaged clutch always unloads the clutch to be disengaged.

A servomechanism is employed in the control system to assure a continuous positive speed relationship between the hydraulic units and the planetary differentials to provide synchronous speed for clutch shifting.

Extensive Prony-brake tests show an operating efficiency of from 87 to 92 percent for the 40-hp prototype in the range from 130 to 1800 rpm.

TOOL ENGINEERING in Europe

By M. Kronenberg
Consulting Engineer
Cincinnati 6, Ohio

Grinding Wheel Research

A report, published by O. Kienzle and H. Muennich, on grinding wheels subjected to centrifugal and cutting forces deals with research work sponsored by the Ministry for Economic Affairs of the State 'Nordrhein-Westfalen" in West Germany. The report is available at Westdeutscher Verlag Koeln-Opladen under the title "Forschungsberichte des Wirtschafts-und Verkehrsministeriums Nordrhein-Westfalen. Feststellung der Spannungen. Dehnungen und Bruchdrehzahlen der unter Fliehkraft and Bearbeitungskraft beanspruchten Schleifkoerper."

Wheels were examined at speeds varying between 0 and 40,000 rpm. Critical factors were measured with strain gages and the stresses due to centrifugal forces calculated. The method and evaluation of results are described, as well as stress-strain curves plotted for wheels of varying grades of hardness. Wheels subjected to bending tests in this case were found to have a modulus of elasticity greater than that found by tensile tests. Mounting pressure was measured and the strain in the rotating wheel was found to be in agreement with that calculated from the elastic constants.

The tests disclosed that the peripheral breaking speed of vitrified wheels increase with a decreasing ratio of internal to external wheel diameters and with increasing hardness of the wheel. Strain produced by the grinding forces is considerably smaller than centrifugal forces.

Truing of Grinding Wheels

The wear of truing diamonds, measured in tests by K. E. Schwartz, is described in an article published in *Industrie Anzeiger*, February 7, 1958, under the title "Zerspanungsvorgange und Schleifergebnis beim Abrichten von Schleifscheiben mit Diamanten."

Cutting forces, resolved into two components, were measured in a specially designed device. Wear of the diamond was measured while the effect of truing on the workpiece finish was determined in terms of surface roughness. Ceramically bonded wheels of different hardness and grain size were used.

The cutting force components on the diamond are of the order of $3\frac{1}{2}$ ounces and $52\frac{1}{2}$ ounces respectively. Their ratio is usually about 1:15, depending upon the shape of the diamond. A sharp diamond usually causes lower forces than a dull one. An increase in force occurs in the first stages of dulling.

Truing of fine grained wheels requires higher forces than truing of coarse ones. More grains are passing the diamond in the former case and coarse wheels contain internal voids, which permit easier fracturing of the abrasive particles.

The wear of the diamond was determined by measuring the area of the diamond at regular intervals and making photographic records. It was found that the wear of the diamond is independent of wheel hardness, but varies considerably with speed and feed of truing. Surface finish of the workpiece improved with increased truing speed.

The influence of the varioius factors on cost is also discussed in the article, as well as the relationship between chatter marks and truing. To remove chips sticking between grains of the wheel, dressing feeds of 0.004 to 0.008 ipm are recommended.

Measuring of Forces with Ultrasonic Energy

Measuring compressive forces by ultrasonic energy is discussed in an article appearing in *Werkstatt und Betrieb*, No. 5, 1958, under the title: "Ein neuartiges Verfahren Zur Messung von Druck Kraeften mit Ultraschall." The method, described by H. Kraechter, is based on the finding that the interface of two highly polished plates permits transmission of ultrasonic waves when the two plates are pressed together. The amount of ultrasonic energy transmitted is proportional to the applied load; the rest of the energy exceeding this load is reflected back into the plates.

It is possible to use this principle for measuring compressive forces with an accuracy of ± 1.5 percent extending over the entire range of low and high pressures. The lowest applied pressure was about 45 psi; highest was about 30,000 psi.

Ultrasonic energy of constant frequency is fed into the upper plate and a compressive load applied. The energy passing from the upper to the lower plate at that load can be measured from the oscillographic pattern produced. Several illustrations in the article show the pattern of the oscillogram as affected by the applied load.

Electromagnetic Clutches

An instructive article on design and selection of electromagnetic clutches was published by W. Baumann in the same issue of *Werkstatt und Betrieb*. The author discusses the design of magnetic clutches, including the theoretical mathematical principles, oscillograms and other data. The article deals primarily with the progress made by the design of such clutches without contact rings which have given trouble in the past. The title of the article is: "Konstruktions Merkmale und Auswahl von Schleifringlosen Elektro-Magnet Lamellenkupplungen."

World's Fair at Brussels

Machine tools of Czechoslovakian origin, exhibited at the Brussels World's Fair are discussed by A. Kanka in a special issue of *Czechoslovak Heavy Industry*. Supported by illustrations, the author describes semiautomatic copying lathes, horizontal boring machines, gear grinding machines and internal grinders.

Centralized control of the horizontal boring machine, combined with remote control of all functions, enables the operator to operate the huge machine from the most convenient position. Movements are measured by a precision rack and electrically transferred to the disk gages on the control panel. Readings to an accuracy of 0.0008 inch are possible. Accuracy and rigidity of all principal moving parts are improved by use of automatic clamping devices operated during the machining cycle.

Punched cards facilitate speed and feed changes of the semiautomatic copying lathe. Contact pins, inserted into the punched cards, electrically control the start of the hydraulic system and change the spindle speeds. Speeds and feeds are infinitely variable with remote control possible even during operation.

Flanks of straight and helical gear teeth are finished on the grinder by hobbing with either the front edge or the conical surface of the grinding wheel. The first method is more accurate but less efficient. Output ratio is about $2\frac{1}{2}$:1 in favor of the less accurate method of grinding with the conical surface of the wheel.

Ultrasonic and spark erosion machine tools are described by J. Zizala. The largest machine of this type is designed for making dies, molds, press tools, drilling holes and thread cutting. The maximum area which can be machined with one tool is 10,000 sq mm (or about 15 sq in.).

Trade Literature

for free booklets and catalogs—use convenient request card, page 139

Duplicating Machines

Illustrated 12-page brochure, "Quick Facts to Aid in Selecting Die-Less Duplicating Equipment," describes work, uses and advantages of various types of Di-Acro equipment and lists specifications for each. O'Neil-Irwin Mfg. Co., 830 Eighth Ave., Lake City, Minn. **L-7-1**

Epoxy Resins

Comprehensive summary of uses of epoxy compounds in various industries offered in illustrated 8-page brochure, "Epoxy resins—applications and advantages"; three major divisions cover plastic tooling, potting and impregnating, and coating and adhesion. Marblette Corp., 37-31 Thirtieth St., Long Island City 1. N. Y. **L-7-2**

Castings

Twenty-page Bulletin 29, "How to Machine Meehanite Castings" presents in detail machining data on various types of castings divided according to type of machine tool on which each operation is performed; serves as set-up guide and gives details as to feeds, speeds, depths of cut, type of tool, etc. Request only on company letterhead direct from Meehanite Metal Corp., 714 North Ave., New Rochelle, N. Y.

Throwaway Tooling

Concise, practical information incorporated in illustrated booklet, "Throwaway Tooling Set-up and Follow-Thru;" Outlines suggestions for obtaining maximum results from such tooling through proper use of correct holders and inserts; feature sections include: Nine factors determining proper selection of a mechanical toolholder and insert; Guide to grade selection; and Eight guides to maximum insert performance. Adamas Carbide Corp., Kenilworth, N. J. **L-7-3**

Pressroom Equipment

Catalog No. 85 shows and describes units in line of automatic pressroom equipment including U. S. slide feeds, roll feeds, air-operated feeds, stock straighteners, stock reels, coil cradles, combination cradles and straighteners. Includes specifications and dimensions. U. S. Tool Co., Inc., Ampere (East Orange), N. J. **L-7-4**

Work Drivers

Bulletin D-57 describes company's automatic work drivers for use on any type of engine lathe, multiple tool lathe or plain or universal grinder; well illustrated with dimensional drawings to show details of various type and size drivers. Seneca Falls Machine Co., 13 Fyfe Bldg., Seneca Falls, N. Y. **L-7-5**

Parts Feeders

Complete data and specifications of standard electromagnet-driven bowl type models, electromagnetic transfer-and-storage models, and hydraulic and/or pneumatic powered bowl-type units provided in illustrated 16-page catalog of vibratory parts feeders and parts feeder components. Syntron Co., 340 Lexington Ave., Homer City, Pa. **L-7-6**

Heat Treat Equipment

Comprehensive information on heat treating equipment contained in 76-page Salt Bath Furnace Catalog 117; technical data includes austempering and martempering curves, charts showing penetration times for carburizing, heating rates for typical steel, radiation losses and other factors; separate section devoted to mechanized salt bath processes; also includes more than 50 on-the-job installation pictures. Request only on company letterhead directly from Ajax Electric Co., Frankford & Delaware Aves., Philadelphia 23, Pa.

Gage

Four-page leaflet No. M54 presents Intrimik for measuring bores and holes directly without masters; describes main features and advantages and illustrates operation and use; Brown & Sharp Mfg. Co., Providence, R. I. **L-6-7**

Clamps

Catalog No. 500 introduces Series 5 clamps pointing out the 16 different configurations to the basic size and emphasizing the versatility, and advantages adaptability of the line; well illustrated. Consolidated Equipment Co., Inc., P.O. Box 2216, Pawnee Ave. at K42 Hwy., Wichita 1, Kan. **L-7-8**

Fasteners

Extensively illustrated with drawings and photos, 24-page Catalog No. 85-A presents information on patented principle, design details, uses and special advantages of Nylok self-locking fasteners for use in all types of manufacture to commercial and government specifications; includes lists of dimensions and specifications for each type of fastener. Request only on company letterhead direct from The Nylok Corp., 611 Industrial Ave., Paramus, N. J.

Die Casting Alloys

Properties and industrial applications of Di-Metal die casting alloys described in 32-page illustrated techincal booklet; lists die casting alloy specifications of ASTM, SAE, U.S. Army, U.S. Navy and Aeronautical Material Specifications; tabulated data permits ready comparison of properties of zinc alloys with alloys of other metals. Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5, N. Y. **L-7-9**

Lathes

Basic machine information and 39 different job applications are presented in Form 1159-C which discusses design principle of Simplimatic automatic lathe. Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis. **L-7-10**

Casting Facilities

Pictorial description of 27,000 sq-ft facility for producing both ferrous and nonferrous precision castings presented in 16-page "illustrated tour" from plant's tool and die shop through to the inspection department. National Precision Casting Corp., P. O. Box 396, Paoli, Pa. **L-7-11**

Graphite

Common questions about colloids answered with discussions, drawings and pictures in 12-page booklet, "ABC's of Colloidal Dispersions"; various sections include What is Graphite? What is Colloidal Graphite? Why is a Colloidal Dispersion Better Than a Dry Powder? Why is Graphite Dispersed in Various Fluids? What is Molybdenum Disulfide? and What Other Solids Do We Disperse? Acheson Colloids Co., Port Huron, Mich. **L-7-12**

Form Tools

More than 1500 standard items made up of circular form tools and blanks presented in illustrated 16-page Catalog 58; also contains material on determination of correct width cutoff tool to use to save part material and improve operating efficiency, better production procedures, recommended cutting angles on various materials, and proper sharpening procedures for form tools. Request directly from Somma Tool Co., 109 Scott Rd., Waterbury, Conn.

Feeder

Illustrated leaflet, Brochure B-32, describes Disc-O-Matic which feeds, orients and counts up to 400,000 units an hour. U. S. Engineering Co., 40-24 22nd St., Long Island City 1, N. Y. **L-7-13**

Tool Steels

Three technical manuals about tool steels used in industrial production include "Tool Steels for Forging Operations," "Tool Steels for the Die Casting Process," and "Tool Steels for the Hot Extrusion Process." The first treats use of various grades for hot forging; illustrations and charts provide data on recommended heat treatment for dies in drop forging; insert, extrusion and preloaded dies, and provides other pertinent information. The second itemizes essential characteristics of die steels, analyzes requirements for die casting tools and gives data on quenching, tempering, nitriding and influence of lubrication. The third brochure covers improvements made in recent years in extruding steel and other stronger and harder metals. Sketches and cut-away drawings illustrate a discussion of extrusion process. Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 22, Pa. **L-7-14**

Drill Press Vise

Fourteen-page pocket-size guide, "Step up Production!" describes AMF Float-Lock® Instant Change drill press vise for all production setups and explains its usefulness for converting conventional drill press and bandsaws into complete machine tools; illustrated with photos and drawings. AMF Tool Div., 224 Glenwood Ave., Bloomfield, N. J. **L-7-15**

Drives

Eight-page brochure presents pertinent information on Marvex infinitely variable speed eddy current drive; explains construction details, design factors and operating principles and emphasizes application advantages and operating efficiencies; illustrated with dimensional and cut-away drawings. Cone Drive Gears Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. **L-7-16**

Gage Blocks

Information on gage block inspection service and gage block sets presented in two bulletins: Bulletin 8-3 covers types of gage block sets available, including rectangular and square in steel and tungsten carbide; Bulletin 8-5 describes need for and availability of two types of gage block inspection. Fonda Gage Co., Inc., Stamford, Conn. **L-7-17**

Brazing

Pocket-sized, 28-page "Brazing Manual" is useful for self-instruction, in-class or on-the-job training in metals joinery; contains illustrated data for brazing shapes, sheet, castings, tubing and assemblies of copper, brass, steel, aluminum and cast iron; written in simple terms, with diagrams to clarify various points. All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N. Y. **L-7-18**

Epoxy Compounds

Technical Data Bulletin 6040-1 introduces complete family of Hysol 6040 liquid epoxy base resin compounds from which can be formulated a broad selection of filled and colored compounds; incorporates a data chart of three selected 6040 base resins showing comparative properties when used with five hardeners. Houghton Laboratories, Inc., Olean, N. Y. **L-7-19**

Broaching

Illustrated brochure describes broach and tooling services as well as company facilities available to customers; shows types and varieties of specialized equipment in company's plant. Apex Broach Co., Inc., 6401 E. Seven Mile Rd., Detroit 34, Mich. **L-7-20**

Readers' Viewpoints

. . . economic lot size

To the Editor:

Congratulations to Mr. Langier for his excellent coverage of the economic lot size problem, especially the compact TABLE 1 which solves the basic formula for practical ranges of all variables involved. Because spatial interpolation is easier than numerical interpolation, however, we will undoubtedly continue to use Van D Mark circular slide-rules for finding lot sizes at Barber-Colman.

The Langier article should not convey the impression that only two mathematicians have solved the economic lot size problem, because it has been worked out many times under a variety of assumptions. The main contribution of the Varnum formula is the consideration of the effect of travel time and manufacturing time. Langier's TABLE 2 is a clever device for quickly determining this effect and is a useful "fellow-traveler" for the Varnum formula.

Edward C. Varnum
Head, Operations Research
Barber-Colman Co.
Rockford, Ill.

. . . barrel finishing

To the Editor:

I wish to take this opportunity to discuss an article, written by Mr. R. F. Enyedy of Westinghouse, Elmira, New York.

Mr. Enyedy knows much more than I do about barrel finishing. I know only the general field and what some people can and are doing with this method of finishing. What I wish to discuss are screw machine parts as shown in *Fig.* 1 and *Fig.* 2 in the article.

I wish to disagree vehemently with anyone or everyone who talk of screw machine parts, such as those shown, in the same breath with cutoff burrs. My complaint is that people in captive shops haven't the know-how or ingenuity to produce parts of this type without the burrs. Then the people responsible call on their own plant people like Mr. Enyedy to solve what to them is an insurmountable problem.

I speak for all job shops who say "Approximately 90 percent of such parts as the two shown can be dropped off a screw machine completely deburred."

My argument is neither with you nor Mr. Enyedy but I felt that I had to say something. I have reached the saturation point and wish I could get this into the hands of the people who should be told what can be done with a screw machine, people who for the most part run by antiquated methods.

Seymour L. Shafer
S. L. Shafer Co.
1104 St. Paul St.
Rochester 21, N.Y.

. . . automation curriculum

To the Editor:

I have read with interest Professor Linsky's article "Professional Education for Automation Engineers" in your April 1958 issue. Though we do not offer any courses in tool engineering as such here at the University of Vermont, this has been my major field of interest for some time.

The trend in engineering education has been away from specialization. This trend seems to be supported by influential people in industry and particularly so by people in research. Yet those of us who are close to manufacturing realize a definite and growing deficiency as a result of this trend. Tool engineers have been a minority group among engineers and their needs for specialization have been somewhat frowned upon as far as equal status in an engineering curriculum is concerned.

The curriculum suggested in this article has merit. However, a few weak points in the curriculum have occurred to me. To do a good job, this would become expensive for laboratory equipment. Since the total enrollment throughout the country would be relatively small, these facilities should be concentrated in a small number of schools. Also, difficulty in securing qualified instructors would point to a few schools offering such a program.

I question the benefit of some of the advanced specialized courses. I suspect that a large percentage of the students will not have had sufficient experience to fully grasp the significance of the subject material. In fact, it might conceivably become harmful in that students gather wrong impressions. I believe a person cannot possibly comprehend the implications and ramifications which can and do arise in industry until that person becomes a part of such a situation. This cannot be duplicated in a classroom.

For these reasons, I would rather see these advanced courses set up as an extension of a more basic tool engineering curriculum.

Gilbert A. Marshall
Associate Professor
The University of Vermont
Burlington, Vermont

who's meeting and where

July 6-11. The Pennsylvania State University. Summer engineering seminar on the mechanical properties of materials. Direct inquiries to Engineering Seminars, Extension Conference Center, The Pennsylvania State University, University Park, Pa.

July 7-11. Colorado State University. Summer institute in technical and industrial communications. Complete information is available from Chairman, Dept. of English and Modern Languages, Colorado State University, Fort Collins, Colo.

July 8-12 and **July 14-18.** Massachusetts Institute of Technology. Successive special summer programs are, respectively, on fundamentals of strain gage techniques and on the applications of strain gage techniques. To obtain details, write Dr. William M. Murray, Prof. of Mechanical Engineering, M.I.T., Cambridge 39, Mass.

July 23-26. National Tool & Die Manufacturers Association. Summer meeting, Mount Washington Hotel, Bretton Woods, N.H. More information is available from association office, 907 Public Square Bldg., Cleveland 13, Ohio.

Aug. 3-8. Pennsylvania State University. Engineering seminar on automatic controls. Additional information may be had from Extension Conference Center, The Pennsylvania State University, University Park, Pa.

Aug. 11-16. Case Institute of Technology. Short course on Numerical Machine Tool Control for engineers in the machine tool and allied industries.

Sept. 2-6. University of Kansas. Third annual Midwest work course on "Plant Layout and Facilities Planning," University Extension Center, Kansas City, Mo. Address inquiries to Midwest Work Course on Plant Layout & Facilities Planning, 4112 Eaton St., Kansas City 3, Mo.

good READING

ENGINEERING FORMULAS AND TABLES—*Published by Lefax, Ninth & Sampson Sts., Philadelphia 7, Pa. 396 pages. Price $4.75.*

Basic formulas, design data and tables of engineering data are contained in this loose leaf reference manual. Most used data has been digested in handbook style for the various subjects, including mathematics, measures, materials, mechanics, electricity and magnetism, screw standards, and hydraulics. The loose leaf arrangement permits addition of data without affecting basic organization of the book.

CREATIVITY, A BIBLIOGRAPHY—*Published by Industrial Relations News. 230 W. 41st St., New York 36, N. Y. 16 pages. Price $2.*

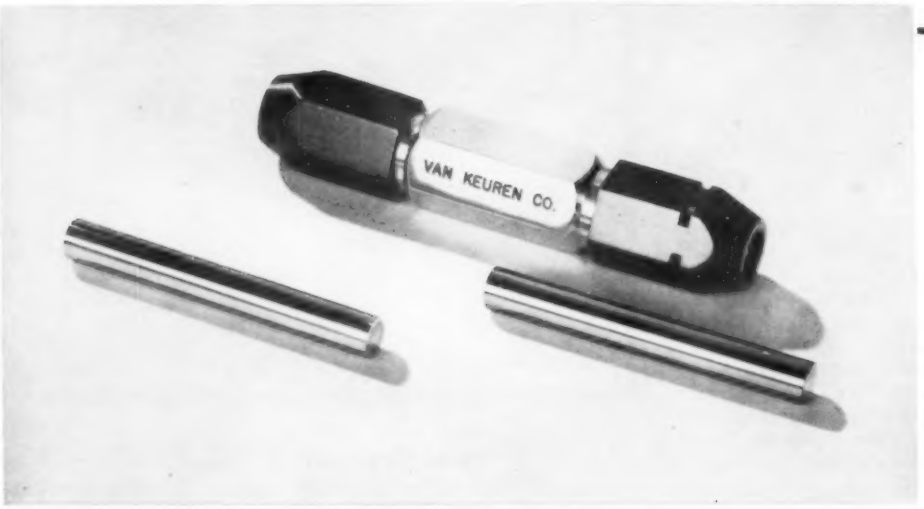
This brochure is a comprehensive bibliography on creativity in science, engineering, business and the arts. It has been prepared by Deutsch and Shea Inc., Technical Manpower Consultants. The articles are arranged alphabetically by author name or publication name, if staff written.

MANUFACTURERS' AGENTS' GUIDE, 1958—*Published by the Manufacturers' Agent Publishing Co., 505 5th Ave., New York 17, N. Y. 150 pages. Price $10.*

This guide contains listings of more than 10,000 manufacturers who distribute their products through manufacturers' agents. It includes information on principal products, estimated credit rating and the name and title of the sales executive. Other information contained in the book describes the services required of manufacturers' agents to manufacturers and data on operations of these agents.

IMMEDIATE DELIVERY

Van Keuren Wire Type Plug Gages



WIRE TYPE (REVERSIBLE) PLUG GAGES were originated by **THE VAN KEUREN CO.** in 1923, and since that time have been supplied to an ever expanding group of manufacturing concerns throughout the country and abroad. The wire type design has enjoyed tremendous popularity because of the inherent economy represented by the fact that the gage units can be reversed, or cut off, to obtain substantial increase in gage life.

As a result of our long experience in developing and pioneering the manufacture of wire type plug gages and the sale of millions of these units, we have come to know what sizes will be required during a given period of time, and have prepared ourselves by finishing in advance a multitude of units which are in constant readiness for shipment. Our methods of size prediction through research and sales analysis have been successful to the point that there is now better than a four out of five chance that at any time we will have on hand the gage or gages that you need. In addition improved and highly efficient methods of manufacture developed during the years of our work in this field make possible the manufacture, to your requirement, of any size not on hand, in an incredibly short time.

VAN KEUREN WIRE TYPE PLUG GAGES are made to the most exacting requirements as to diameter, roundness, hardness, stability and surface finish. They are offered in all tolerances from XXX (.00001") to ZZ, and are available as units, in handles, or in sets.

Send for a copy of the new, 258-page Van Keuren Catalog and Handbook No. 36 containing complete details as well as valuable technical and engineering information on measuring problems and methods. Address:

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174 WALTHAM STREET, WATERTOWN, MASS.

Optical Flats . . . Light Wave Equipment . . . Light Wave Micrometers . . . Gage Blocks . . . Wire Type, Taperlock and Trilock Plug Gages . . . Master Setting Disks . . . Thread Measuring Wires . . . Gear Measuring Wires . . . Carbide Plug Gages . . . Carbide Pivots . . . Precision Lapping Service.

Tech Digests

use of Penetrating Radiation

in the process industries

By J. E. Jacobs, Manager
Advanced Engineering Lab.
General Electric Co.
X-Ray Dept.
Milwaukee, Wis.

PENETRATING radiation, whether from radioactive isotopes or electronic tube, has many distinct advantages when applied in the process industry. The most important are as follows: (1) it is nondestructive, and at the intensity levels used does not in any way alter the composition of the material examined; (2) the instrument using the radiation need not contact the material; (3) the characteristics of the material may, in most cases, be measured accurately regardless of their physical state; (4) measurements may be taken at material speeds comparable to those currently in use and projected by industry.

All use of penetrating radiation depends upon the principle that each material absorbs or scatters a precise amount and quality of radiation that depends on the mass, chemical composition and physical structure of the material. This characteristic is used in a variety of ways in designing the instruments utilizing penetrating radiation. These may be divided into four classifications as follows:

Gaging—The mass of the material and hence its thickness is measured by the absorption or scattering of a beam of radiation.

Localization—Any abrupt change in the absorption of the material such as would result from an occlusion or flaw is detected. This is similar to the gaging but is treated separately as special high resolution detectors are needed.

Structure Analysis—The radiation serves to "finger print" a compound by determining crystal structure that is unique to that compound.

Elemental Analysis—Permitting one to utilize the excited secondary radiation to identify certain elements with relative simplicity and at high speed.

Sources of radiation may be either radioactive isotopes or X-ray generating tubes. Both are in use, although the X-ray tube generators predominate due largely to the inherent ease of control of the quality of the radiation.

The radioactive isotope, particularly the beta emitters such as strontium-90 and cesium-137, were some of the first products of the Atomic Age to be put into consumer use. Beta rays are electrons emitted spontaneously by certain radiation materials. In contrast to the radiation produced by an x-ray tube, the energy of radiation given off by a radioactive source is not directly subject to control except by changing the material of the source. The intensity of the source decays exponentially at a rate determined by the half-life of the source material and is likewise not subject to control except by shielding. Fortunately, the commonly used beta emitters have half-lives sufficiently long that in many applications they may be con-

Fig. 1. Typical factory installation of a beta ray gage used for inspection of fiber board. The material is checked for thickness at the rate of 500 fpm.

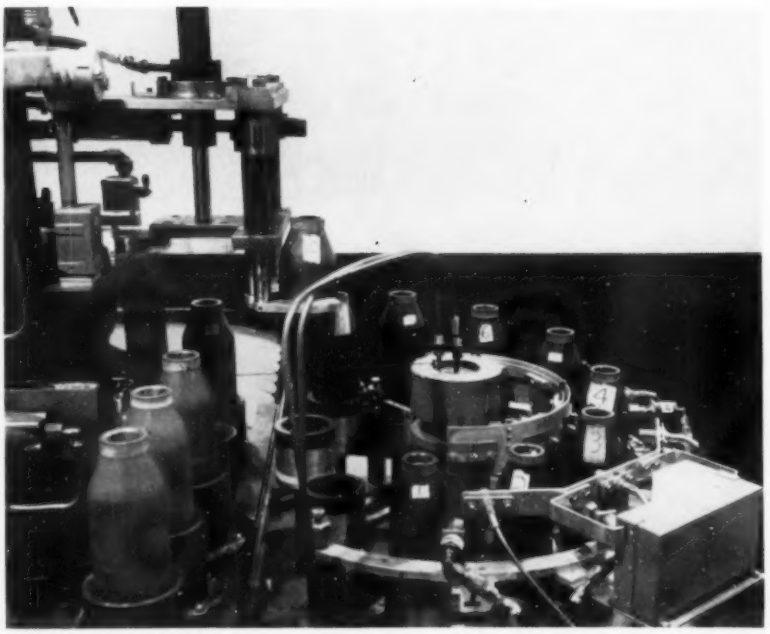

Fig. 2. Rockets are 100 percent inspected in this automatic unit by a combination of rotating and lifting motions. Each station scans 1/7 of the total height and the sensitivity of the unit permits detection of ⅛ inch diam changes, which are considered defects. Inspection rate is 300 rockets per hour.

sidered as having a constant intensity. The stopping power of a sheet of material for beta rays depends principally on its mass per unit and is much less dependent on its chemical composition than is the case with X-rays. Beta rays are, in general, much less penetrating than X-rays and for gaging purposes find their greatest application in the gaging of paper, plastics, rubber and light metals.

Gamma rays are high-energy X-rays emitted spontaneously from the nuclei of radioactive atoms. Bremsstralung are X-rays emitted from a target material bombarded by beta rays. Practical gamma ray sources are available covering a wide range of energies, some of which have a half-life sufficiently long to make them behave as though they were a source of constant intensity. Because of their greater penetrating power high energy gamma rays and Bremsstrahlung are more suitable for gaging thick or heavy metals such as steel or extruded sections.

X-rays are produced by allowing a beam of high-speed electrons to impinge on a target consisting of a heavy metal such as tungsten. The intensity of the beam is a function of the number of electrons impinging on the target while the energy of the beam is dependent on their velocity and hence the voltage applied to the tube. Both are controllable. The amount of X-radiation absorbed by a given material is a function of the energy of the incident beam. In this fact lies the principal advantage of using X-ray sources in gages. By controlling the energy of the x-radiation the optimum absorption conditions may be easily established, which in turn permit the design of a highly sensitive thickness measuring device.

Gaging: Unquestionably the greatest

Fig. 3. An aircraft frame section being inspected for uniformity of honeycomb structure. A conventional closed circuit TV system is used.

use of penetrating radiation in the process industry today is in the field of gaging, *Fig.* 1. It is here that the use of isotopes by industry has gained its greatest foothold. Currently, though, the X-ray gage is making inroads in the light-metal fields heretofore exclusively those of isotope sources. Regardless of the radiation source used, the gaging process depends on the measurement of radiation whether transmitted or reflected by the material. In the case of gages where transmitted radiation is used, the beta emitting isotopes, with their limited penetration, are used extensively on low-mass materials such as fiber, plastic, thin sections of light metals and the widely publicized cigarette package. The ability of a metal to reflect or scatter beta rays in all directions is used in the back-scatter gages which measure thin metal films lying on a base of differing metal. Typical materials speed for such gages is 500 fpm with a long term accuracy of gaging of plus or minus 1 percent. The use of X-ray sources in process industry gages is becoming increasingly wide-spread as detectors are improved and X-ray tubes capable of producing low energy and hence more highly absorbed radiation become available.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

In still another form of X-ray gage the incident X-rays are used to excite the characteristic X-ray spectra of a base metal over which has been applied a metallic plating. The absorption of this back-scattered radiation by the plating metal serves to gage its thickness. An example of this is the gaging of tin plate on a steel sutstrate.

Localization: The amount of radiation transmitted depends on the mass and thickness of the material being penetrated which in turn may vary widely in a small region. This fact forms the basis for a new family of instruments developed for the process industry. These are essentially point-detection devices to find variations in density within a small area occasionally found in uniformly dense objects. The instruments first introduced in 1950 are finding increasingly greater use in the high-speed inspection of a variety of products. The x-ray detector used is a photoconductor, cadmium selenide. An

example of their use is in inspecting closed containers of free-flowing materials and liquids. These gages are capable of detecting changes in level in the order of plus or minus $\frac{1}{32}$ inch at rates of 900 containers per minute. A more elaborate form of this type gage is illustrated by the prototype machine, *Fig.* 2, which has successfully completed a year's evaluation as a link in a semi-automated ammunition plant. Here the machine is fed 3.5 inch rocket charges of cast explosive and through a multiple station mechanical scanning mechanism examines the rocket in its entirety. Each void in the cast charge exceeding $\frac{1}{8}$ inch in volume is recorded in one of seven digital computers. When the total void volume as computed in a given one of the seven regions exceeds that known from ballistics to be safe the defective region or zone is marked. The inspection machine functions in a completely automatic manner and following each inspection cycle rechecks itself against a known standard for accuracy of measurement. The rate of inspection of the rockets by this machine is approximately 300 per hour.

In some applications this inspection rate is adequate. However, in the majority of cases a faster rate is needed. This requirement of higher inspection rates necessitated the development of a high-speed electronic scanning system.

The new system, known as TVX, utilizes an X-ray sensitive television camera tube. Here the complete X-ray image of the material to be inspected is projected on the face of the special pickup tube. This received image is converted to an electrical charge pattern which is then scanned by an electronic beam and made available for viewing, *Fig.* 3, or in the case of an automatic system, used to eject the defective object. Such a completely automatic system, while still in the developmental stage, promises to be of inestimable value in the automatic quality control of complex assemblies and processes.

Future Trends: The increasing widespread use of penetrating radiation is due largely to the demands of continuous flow processes for a high-speed, noncontacting, accurate and above all, nondestructive control instrument. The applications cited are merely the first attempts of the industry to satisfy these needs. In the field of gaging, the low energy X-ray generator-detector system is invading fields which have been exclusively dominated by the beta emitting isotopes. The advantages of controllable quality of radiation which is inherent in the X-ray generator is a decided factor in favor of such systems. How far this trend continues depends on the ability to instrument to the tolerances required.

The availability of the X-ray scanning transducer opens up vast new fields for the complete automatic inspection of products which, due to their complex nature, required the interpretation available only to the human eye-brain combination. The limitation of such applications is only that of the ingenuity of the designer.

It is in the fields of material analysis both as to structure and elemental content that penetrating radiation is of maximum value. One of the largest problems existing in the process industry today is that of accurately and rapidly measuring these properties of a material.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

From a paper presented at the Conference on Instrumentation and Control in Process Industry, sponsored by Armour Research Foundation of Illinois Institute of Technology, Technology Center, Chicago, Ill.

Requirements of a Precision Grinding Wheel Power Package

By W. E. Happel
Asst. Chief Engineer
The Landis Tool Co.
Waynesboro, Pa.

Power for precision grinding wheels is being supplied by power packages to an ever-increasing extent. Two factors have accelerated this trend: first, pressure from important segments of industry for wider application of the package concept of machine tool construction and, second, industry-wide recognition that the complex requirements of wheel drives are better satisfied by integrated design.

Electrical manufacturers have responded to this demand by marketing a wide array of power packs. For the grinding machine builder, appraisal and choice is complicated by a somewhat strange vacillation in customer preference.

One electrical manufacturer, aware of this divergence, decided to re-examine the problems associated with precision grinder wheel power. After discussing the mechanical and electrical problems related to virtrified wheels in diameters from 30 to 42 inches, it was agreed that features of grinding machine power packs should include:

1. 15 to 60 hp
2. A-C power source
3. Total enclosure
4. No auxiliary cooling
5. Motor dimensions not to exceed currently available and comparable equipment
6. Precision dynamic balance
7. Adjustable speed
8. Rheostat speed adjustment
9. 1½ to 1 or 2 to 1 speed range
10. Approximately 1200 to 1800 rpm
11. Constant horsepower
12. Limited starting torque
13. Good electrical efficiency at all speeds
14. Automatic overspeed safety
15. Absolute minimum tune-up adjustment
16. Magnetic controls
17. Maximum floor space conservation.

These features reflect the opinion of Landis engineers. There is no intent to present them as representing the thinking of any machine tool manufacturer. We do, however, stand by our conviction that the requirements as stated are adequate.

Based on a paper presented at the 22nd Annual Machine Tool Electrification Forum at Buffalo, N. Y., sponsored by the Westinghouse Electric Corp., Pittsburgh, Pa.

Dip Brazing of Magnesium Possible, Practical and Efficient

By Wm. J. Graves
Engineering Dept.
Dalmo Victor Co.

Dip brazing is a method of joining metallic parts by submerging them in a molten flux bath whose temperature is below the melting point of the parts to be joined but above the melting point of the brazing or filler alloy.

Four factors must be considered in the design of a magnesium dip brazing fixture:

1. Mass of fixtures should be kept to a minimum size.
2. Flux drainage calls for simple fixture design to facilitate fast, complete drainage of the molten flux from the assembly and fixture.
3. Corrosive action of the flux bath salts, under certain conditions, are highly corrosive to most metals.
4. Thermal expansion between the expansion of the magnesium parts and the steel fixtures must be given careful consideration at the design level.

From a paper presented at the 13th Annual Convention, The Magnesium Assn., 122 E. 42nd St., New York 17, N.Y.

This valve gets a leak-proof seal from a Blanchard Surface Grinder

"The Blanchard Surface Grinder is one of the most important improvements in our modernization program." This report comes from the Commercial Refrigeration Division of Bendix-Westinghouse Automotive Air Brake Company—makers of power and condensing units for refrigeration equipment.

The Blanchard No. 18 Surface Grinder puts a surface of 5 micro inches or better on Bendix-Westinghouse valves at the rate of 75 pieces an hour.

A Blanchard Model 18 Surface Grinder is used to finish grind valve plates used in Bendix-Westinghouse electric refrigeration compressors. They say: "This operation is very important, because—with a surface finish of five micro inches or better—we get a perfect seal on our gaskets and valves, eliminating the possibility of leakage."

Is there room for improvement in *your* surface grinding? For best results...

Write today for your free copy of "Work done on the Blanchard," fifth edition, and "The Art of Blanchard Surface Grinding," fourth edition.

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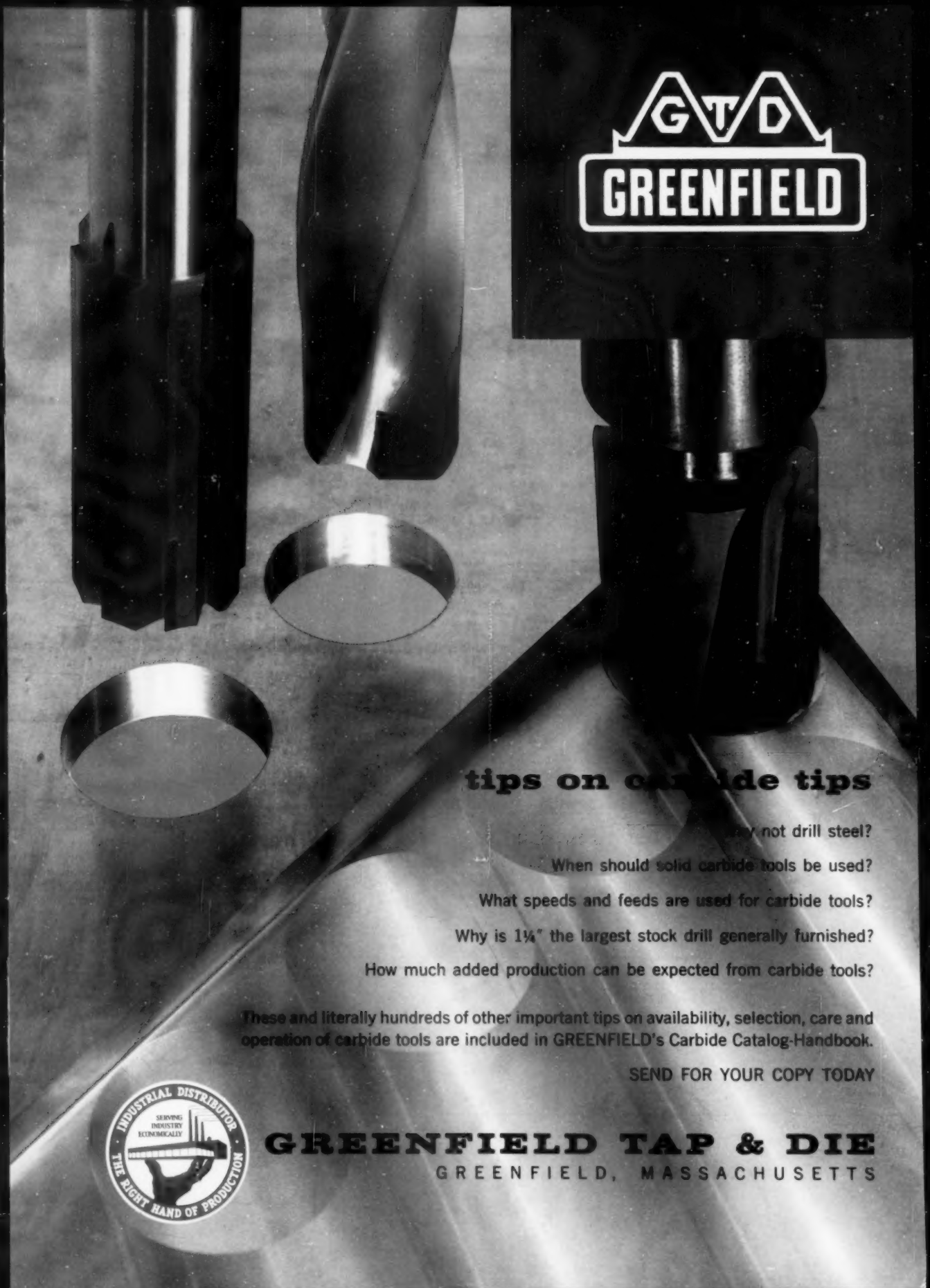
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"They don't make them like they used to". They sure don't, they were good — wonderful — for their day and some of them are still running — like they used to

but — With modern design and performance who would prefer an antique to this model? Yet many a shop is running today with yesterday's tooling.

Are you trying to turn out products to today's specifications with yesterday's tooling? Have you die heads 10-20-30 years old that are "as good as new"?

Better let a Geometric man go over your threading operations and show you how New Geometrics can improve your threading and lower costs too!

CALL YOUR GEOMETRIC DISTRIBUTOR TODAY

GEOMETRIC – HORTON NEW HAVEN 15, CONNECTICUT

Here's the work-horse

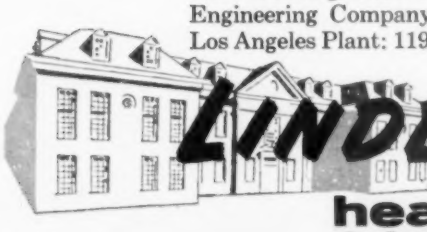
for many a carbonitriding job

This furnace has complete automatic cycle and quench control.

This is the most widely-used carbonitriding furnace of all. Day in and day out production of tons and tons of work has proved this furnace's ability to increase production quality and volume and reduce costs. It is a versatile furnace, too, not only for carbonitriding but for other uses, carburizing, annealing, carbon restoration and many hardening applications.

This type of furnace is available for both manual and automatic operation. It can be equipped either with Lindberg's efficient new vertical radiant tubes for fuel-firing or for electric heating with Lindberg's revolutionary new CORRTHERM element.

Versatile as this furnace is, we don't claim it is the best solution to *every* carbonitriding problem. But, whatever your need may be, talk it over with Lindberg. Our engineers, as they have done in so many instances, will recommend a sound answer—design it, build it, even field-install it if you wish. Just get in touch with the Lindberg plant or the Lindberg Field Representative in your locality. Lindberg Engineering Company, 2447 West Hubbard St., Chicago 12, Illinois. Los Angeles Plant: 11937 S. Regentview Ave., at Downey, California.



LINDBERG

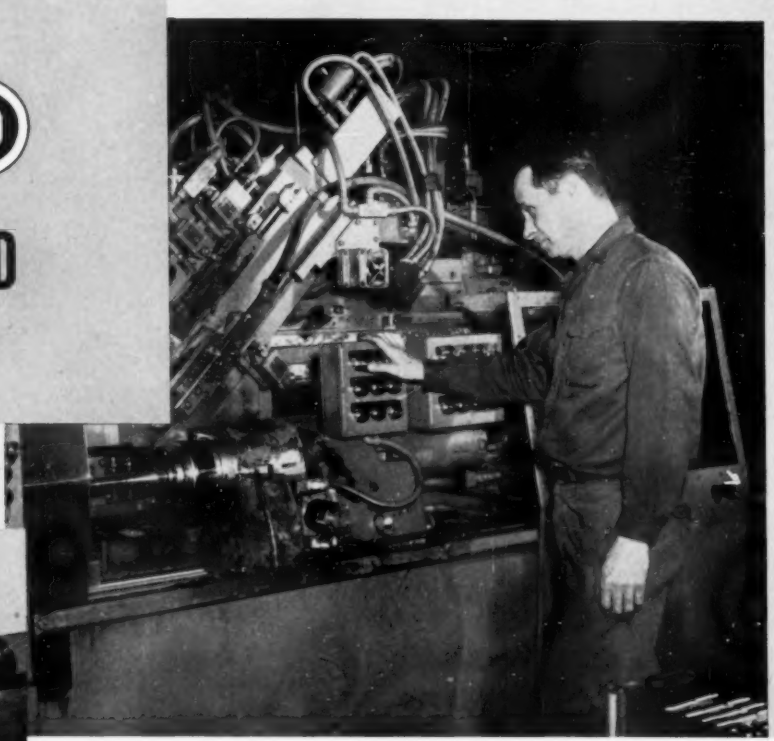
heat for industry

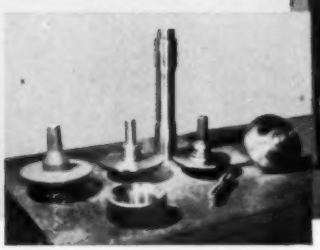
INCREASE PROFITS by REDUCING COSTS with

BULLARD

HYDRA-FEED LATHES

The experience of The National Supply Company, Toledo, Ohio, manufacturers of oil field machinery, as related by Mr. Owen U. Trumbull, Tool Engineer, can be applied to improve your profit picture.





Their BULLARD HYDRA-FEED TRACER LATHE . . .

- ★ Replaced four machines previously used
- ★ Reduced machining operations from ten to four
- ★ Held work to closer tolerances
- ★ Decreased spoilage
- ★ Simplified tooling and set-up

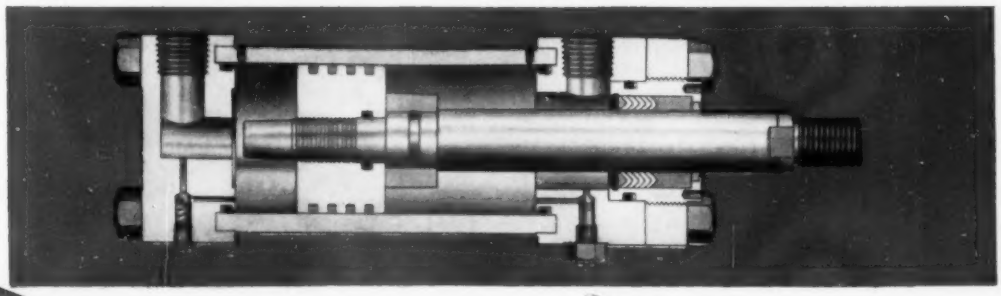
These are all factors that have a direct bearing on profits

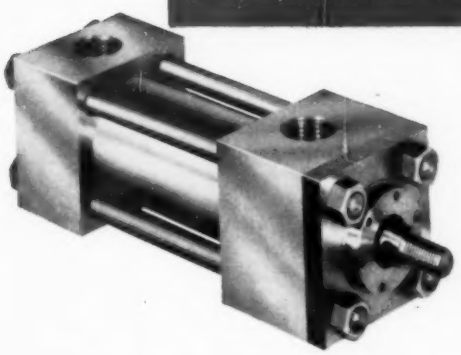
Remember . . . to cut costs when cutting metal . . . Buy BULLARD

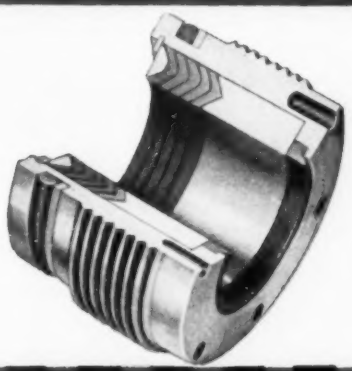
The BULLARD COMPANY

Bridgeport 9, Connecticut

O-M a Power-Full Idea in High Pressure Hydraulic Cylinders







O-M *Series TH*
Heavy Duty Hydraulic Cylinders 2000 PSI Shock Loads 3000 PSI Non-shock Loads Meet JIC Standards

Tested, tried and proved powerful components in today's fast-moving automation picture, these ruggedly constructed O-M Heavy-duty Hydraulic Cylinders breeze through heavy work loads, withstand shocks and strains, and provide smooth, dependable power for a wide range of pressures and operating conditions.

Important design and construction features:

1. Head Seal—"O" Ring with leather back-up washer assures positive seal between head and tube.
2. Heads confine tubing O.D. to prevent breathing and thereby provide additional insurance against leakage under the most severe conditions.
3. Heads are counterbored to pilot in accurately honed tubing to assure perfect alignment.
4. Multiple lip, self-compensating, Vee type rod gland packing.
5. Step-cut ring type pistons are standard, but Vee type pistons are available for holding application.
6. Rod gland cartridge is removable for easy maintenance.

O-M Series TH High Pressure Hydraulic (oil) Cylinders are available in full range of sizes (1½" to 8" bores) with standard and heavy duty piston rods.

Mail Coupon TODAY for Bulletin 105 showing descriptive drawings of cylinders, mounting accessories and capacity chart.

ORTMAN-MILLER MACHINE COMPANY
13 143rd Street, Hammond, Indiana

☐ Have representative call
☐ Send Bulletin 105

Name_____ Position_____

Company_____

Address_____

City_____ Zone____ State_____

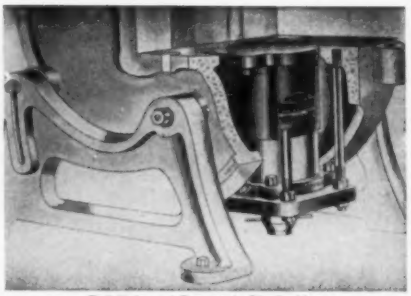
DIE CUSHIONS

Offer 4-Point SUPERIORITY Over Springs, Rubber Bumpers

1
Adjustable compression provides ideal blank holding pressure.

2
Bronze bearing surfaces give maximum stability.

3
Constant pressure assures equal loading at start and finish of draw.



Full Universal Pneumatic Die Cushion

4
Simple mounting, either bolster or press bed. More stable installation possible due to method of suspension.

Write For Catalog F-44-A

DAYTON ROGERS *Manufacturing Company*

MINNEAPOLIS 7R, MINNESOTA

USE READER SERVICE CARD; INDICATE A-7-166-1

ACCURACY .0002 T.I.R.

.0002 T.I.R. or less at Spindle Nose, .0005 T.I.R. or less on Test Arbor six inches from Spindle Nose

SPINDLE SPEEDS 150 and 250 RPM Other Spindle Speed Pulleys Available

MODEL B943 MOTOR DRIVEN WORK HEAD

No. 11 B & S Tapered Spindle Standard Equipment. No. 12 B & S or No. 5 Morse Available at Slight Extra Cost.

Clip ad to your letterhead and send for Literature

K. O. Lee Company, Aberdeen, S. D.

USE READER SERVICE CARD; INDICATE A-7-166-3

Extra Capacity with hall COLLET CHUCKS

for SPEED, ACCURACY, ECONOMY

Automatic adjustment speeds up production in multiple operations with push-out type HALL COLLET CHUCKS. Full spindle capacity or over. Tremendous grip over or under stock size. Without adjustments. Shortest overhang. All grip ... no slip. No bearings ... no heat or lost power. Instant release without stopping lathe.

SATISFACTION GUARANTEED!

Made in Three Sizes to Fit Your Requirements:

Model A ... 1" (max. capacity 1-1/16")
Model B ... 2" (max. capacity 2-1/16")
Model C ... 3" (max. capacity 3¼")

Write today for illustrated catalog and price list—

HALL MANUFACTURING COMPANY
622 TULAROSA DRIVE, LOS ANGELES 26, CALIFORNIA

USE READER SERVICE CARD; INDICATE A-7-166-2

HAVE YOU CHECKED YOUR *COUNTERSINKING COSTS* LATELY?

A *Severance* CARBIDE ECONO-SINK WILL GIVE YOU—

- INCREASED ACCURACY
- MORE PRODUCTION
- SMOOTHER SEATS
- LONGER CONSISTENCY OF OPERATION
- LESS DOWN-TIME
- AND A COMPLIMENT FROM THE BOSS FOR SUGGESTING THE CHANGE

Chatter-Free DESIGN
Solid CARBIDE CUTTING HEADS
MAKE THE Switch to Carbide BEFORE IT'S TOO LATE

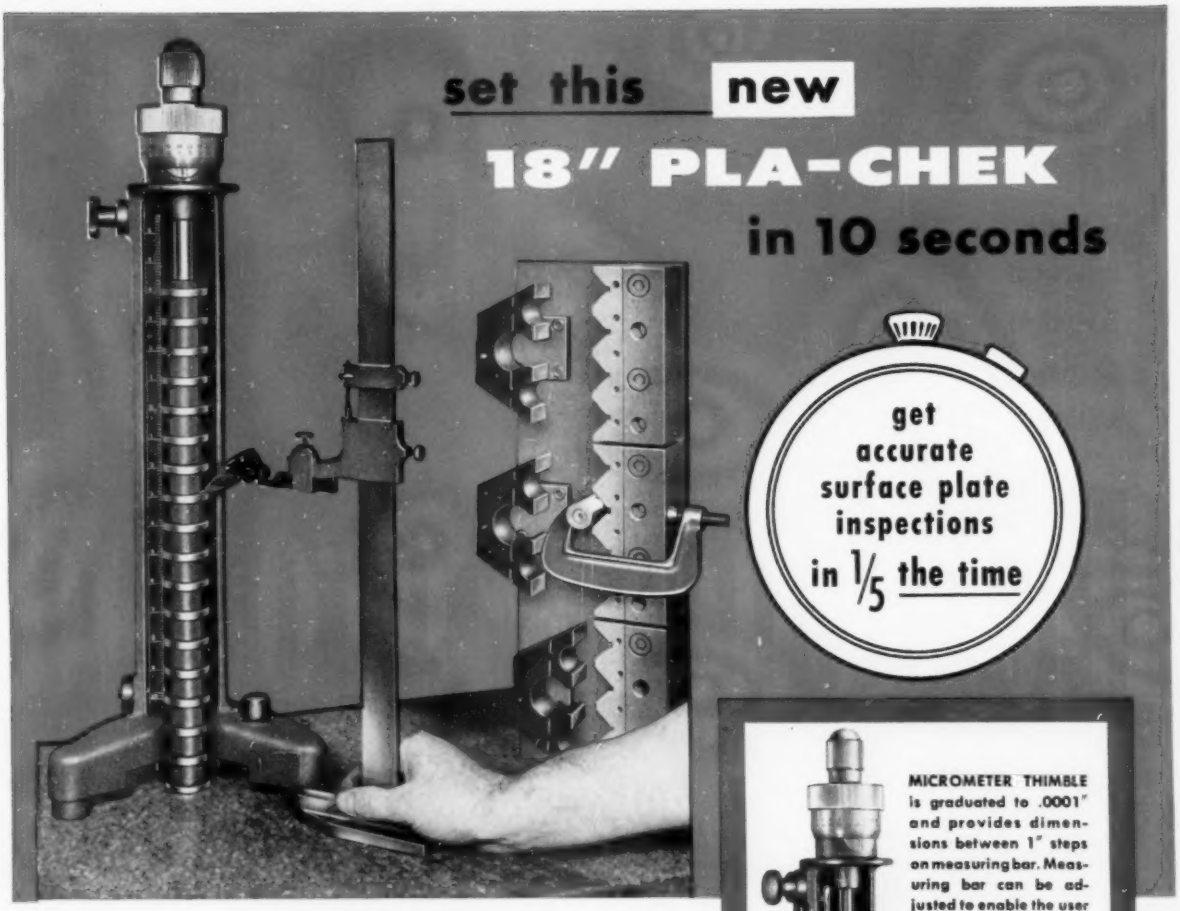
WITH THE NEW Severance CARBIDE ECONO-SINK YOU GAIN ALL THE ADVANTAGES OF CARBIDE TOOLING—AND AT LESS COST per Countersunk Hole

Ask for Information & Prices TODAY!

Severance TOOL INDUSTRIES INC.
728 Iowa Avenue, Saginaw, Michigan

Ask for a Severance catalog today!

USE READER SERVICE CARD; INDICATE A-7-166-4



MICROMETER THIMBLE is graduated to .0001" and provides dimensions between 1" steps on measuring bar. Measuring bar can be adjusted to enable the user to take readings up or down relative to a center line or other reference line on the work.

accurate to .00005" throughout the 18" range

That's right! Just 10 seconds to set this NEW 18" PLA-CHEK GAGE . . . and you are ready to start your inspections. In hundreds of installations on innumerable jobs PLA-CHEK GAGES are daily proving their time-saving and money-saving advantages. Extremely easy to operate—no auxiliary gage blocks are necessary—this PLA-CHEK 18" model guarantees accuracy to fifty millionths through its entire range. The measuring bar is made of deep-frozen, strain-free alloy steel. Because it is of one-piece construction the steps cannot change or separate with age. Since it is not necessary to touch the measuring bar, body heat does not affect it. Return the coupon or write TODAY for literature and complete details.

Cadillac PLA-CHEK GAGES are available in a complete range of sizes: 6", 12", 18", 24", 36", and 48" models. Precision-made risers, increasing the range of each model, are also available.

MAIL THIS COUPON FOR COMPLETE DATA

CADILLAC GAGE COMPANY
P. O. BOX 3806, DETROIT 5, MICHIGAN
Without obligation please rush complete information on the Cadillac PLA-CHEK Gage line to:

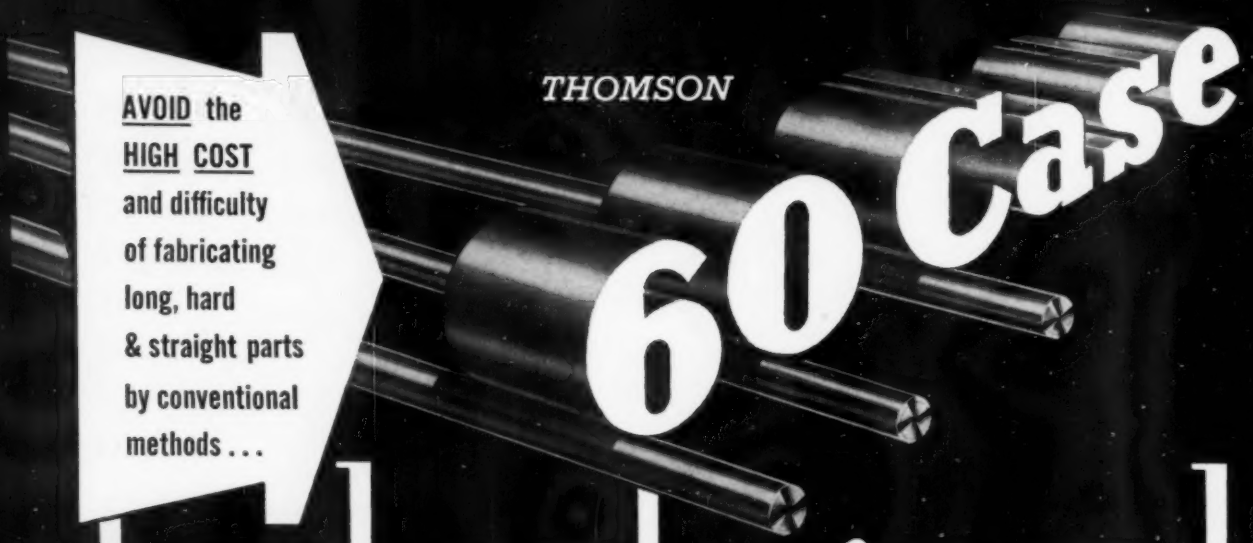
Name_____

Company_____

Address_____

City_____ Zone____ State_____

Cadillac
GAGE COMPANY
P. O. BOX 3806 • DETROIT 5, MICHIGAN



AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods . . .

THOMSON

60 Case

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

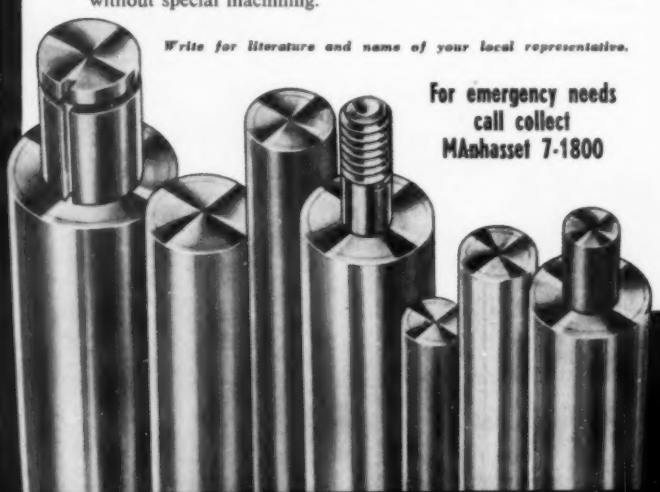
60 Case is the result of over ten years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining.

Write for literature and name of your local representative.



For emergency needs call collect MAnhasset 7-1800

ADVANTAGES of *60 Case*

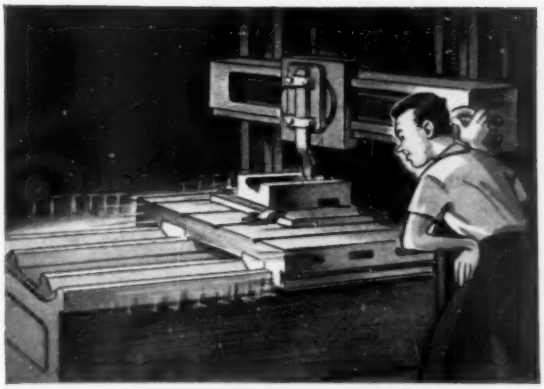
- COST REDUCTION
- HARD BEARING SURFACE
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL *60 Case* PARTS

GUIDE RODS, SHAFTING, ROLLS, TRAVERSE RAILS, PISTON RODS, ARBORS, LEADER PINS, TIE RODS, KING PINS, AXLES, CONTROL RODS, GUIDE POSTS, MANDRELS, BEARING ROLLERS, SPINDLES

THOMSON INDUSTRIES, Inc.

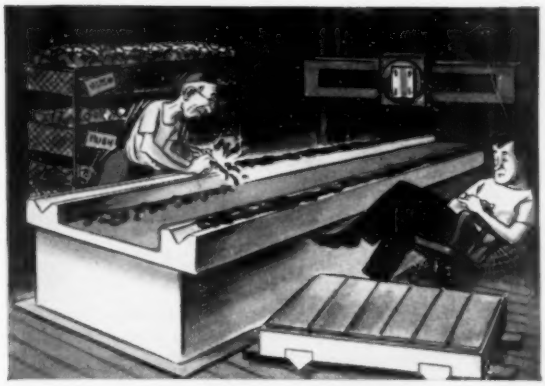
Dept. C2, Manhasset, New York



1. Cures "stick-slip" or "jumpy table". When a table gets the "shakes", especially after it has just reversed or when the load is heavy and the speed slow, it's probably suffering from "stick-slip". Remedy—Sunoco Way Lubricant®. Special polar compounds in Sunoco Way Lubricant form a friction-reducing film that keeps a table sliding smoothly under all operating conditions.

2. Doesn't squeeze out. When you use a heavy oil as a way lubricant, you must use a lot of oil to maintain a thick enough film. But, heavy oil squeezes out if the table sits in one position very long. You have a tough time getting the table moving again. Protected by the tenacious thin film formed by Sunoco Way Lubricant, the machine can be idle for a week and it will start easily.

WHY SUNOCO WAY LUBRICANT CAN HELP CURE YOUR MACHINING PROBLEMS



3. Protects expensive ways. Badly scored or pitted ways, caused by inadequate way lubrication, result in lost production and expensive repairs. The high film strength of Sunoco Way Lubricant eliminates the danger of metal-to-metal contact, the chief cause of scoring and way wear. Excellent metal-wetting and non-corrosive properties eliminate rusting and pitting.

4. Approved by more than 55 machine-tool builders. Every major machine-tool builder has tested Sunoco Way Lubricant. It is always approved. In fact, to assure maximum efficiency of their product, many manufacturers ship a supply of Sunoco Way Lubricant with each machine. We'll be glad to send you the list of manufacturers who have approved Sunoco Way Lubricant.

For more information, see your Sun Representative, or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. TE-7

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

PHILADELPHIA 3, PA.

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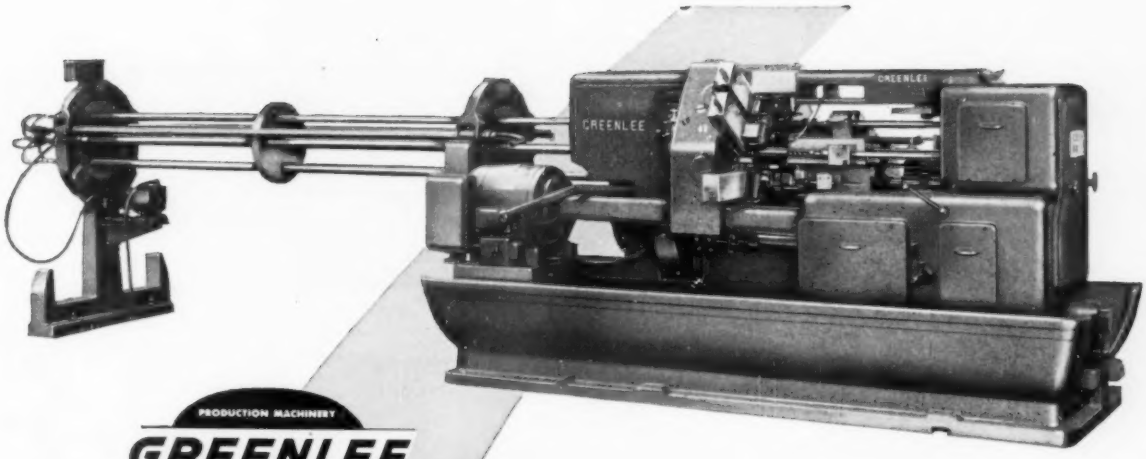
IN CANADA: SUN OIL COMPANY LIMITED, TORONTO and MONTREAL

SUNOCO



PRODUCTION MACHINERY
GREENLEE

AIR-FEED AUTOMATIC

1. **Permits Greater Job Versatility**
2. **Easily Adapted to Multiple Feedouts**
3. **Provides Longer Stock Feedout**
4. **Eliminates Stock Scoring**
5. **Reduces Stock Reel Noise**
6. **Eliminates Stock Pushers**
7. **Eliminates Feedout Cams**

Write today for Catalog A-405, or better still, have the Greenlee man call and show you the way to more profitable production with this air-feed automatic bar machine.

GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines

GREENLEE BROS. & CO.

PRODUCTION MACHINERY
GREENLEE

1987 MASON AVE.
Rockford, Illinois

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-7-171

All "Special" Tools illustrated use *Standard* Kendex inserts, chipbreakers, clamps, shims and screws — simplifies stocking and reduces investment in inventories.

The tougher the competition the BETTER the reasons for tooling-up with KENDEX*

When you have to cut costs to the bone on every machining operation . . . that's when Kendex tooling can do the most for you.

In many shops, Kendex has doubled or tripled output per hour in addition to effecting great savings in machine downtime and through the elimination of costly regrinding . . . all adding up to tremendous savings *per finished piece.*

Kendex Tooling also eliminates costly chipbreaker grinding and the time-loss of tool repositioning after indexing. Kendex greatly reduces tool inventories as several standard types and sizes of inserts and *solid* Kennametal chipbreakers will service dozens of operations. The Kendex inventory involves only a fraction of the investment required to stock ordinary tools for the same operations.

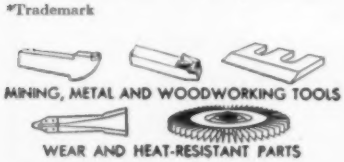
Then, if you are adapting standard tools to specialized jobs, by all means investigate how easy it is to apply the Kendex principle to the special tooling you really need. Illustrated are a few of many special Kendex tools that are speeding production and squeezing profits out of close-margin jobs.

And don't forget—Kennametal Tooling Service provides you not only the finest in tools, but the cooperation of a Kennametal Service Man, who will work with your personnel in selecting, designing, and applying the proper tool for your tough operations. If desired, he can conduct "on the job" instruction for your operators.

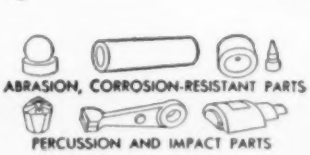
More competitive times are a threat to the weak—but a challenge to the strong! Why not call in one of our representatives and find out the many ways to reduce machining costs per unit. Just get in touch with your nearest Kennametal office or write KENNAMETAL INC., Latrobe, Pennsylvania.

*Trademark

3141



INDUSTRY AND
KENNAMETAL
...Partners in Progress

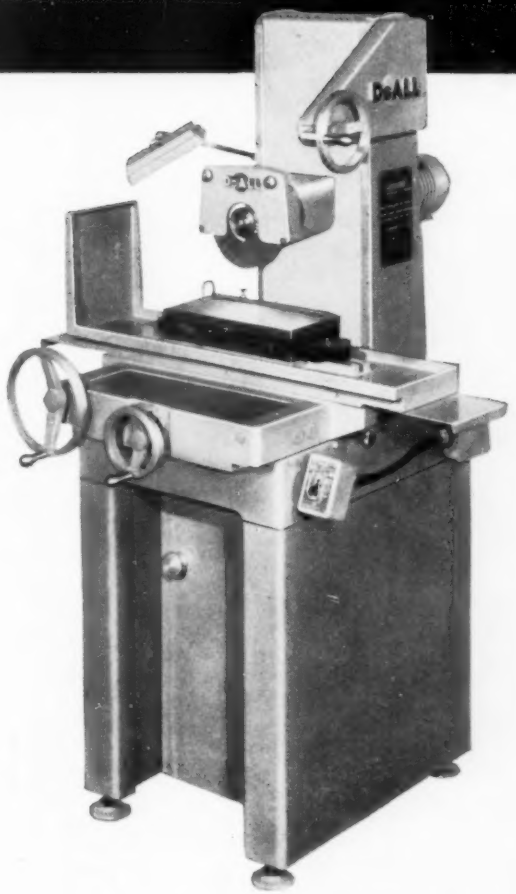


DoALL Announces . . .

a NEW Super Precision Hand-Operated SURFACE GRINDER

Joining the Family of Fine DoALL Precision Surface Grinders

MODEL DH-612



Tailored to Fit the Operator for Easier, More Productive Work

- **NEW-DESIGN VERTICAL FEED HANDWHEEL** in easy-to-reach, safe position
- **ADJUSTABLE MACHINE OPERATING HEIGHT**
- **SMOOTH TABLE ACTION**—manual traverse through timing belt drive (hydraulic drive optional)
- **RIGHT- or LEFT-HAND TABLE DRIVE**—handwheel position instantly interchangeable
- **VERTICAL HANDWHEEL** graduated in tenths (Zero Slip Rings optional)
- **SADDLE LOCK** for form and plunge grinding
- **1 H.P. MOTORIZED SUPER PRECISION SPINDLE** with anti-friction bearings
- **KNEE-RECESSED** cabinet base

"Human Engineering" guided DoALL engineers in the design of this new surface grinder. Low in cost yet superior in accuracy, it is manufactured to set completely new performance standards in a hand-operated surface grinder.

Every design feature and control function was carefully considered for the operator's convenience. Now the most exacting work may be turned out with least operator fatigue. With tolerances closer than ever before, this assures users of the Model DH-612 a definite competitive advantage.

Standard machine includes not only the exclusive features above, but also telescoping dust guards and one-shot lubrication system to table, saddle, column ways, elevating screw, gears and bearings. A full range of optional accessories is available including "Cool Grinding" through-the-wheel mist coolant system. Table travel is 7" x 13"; work height, 0 to 12¾"; vertical feed to .0001" and crossfeed with vernier to .0002".

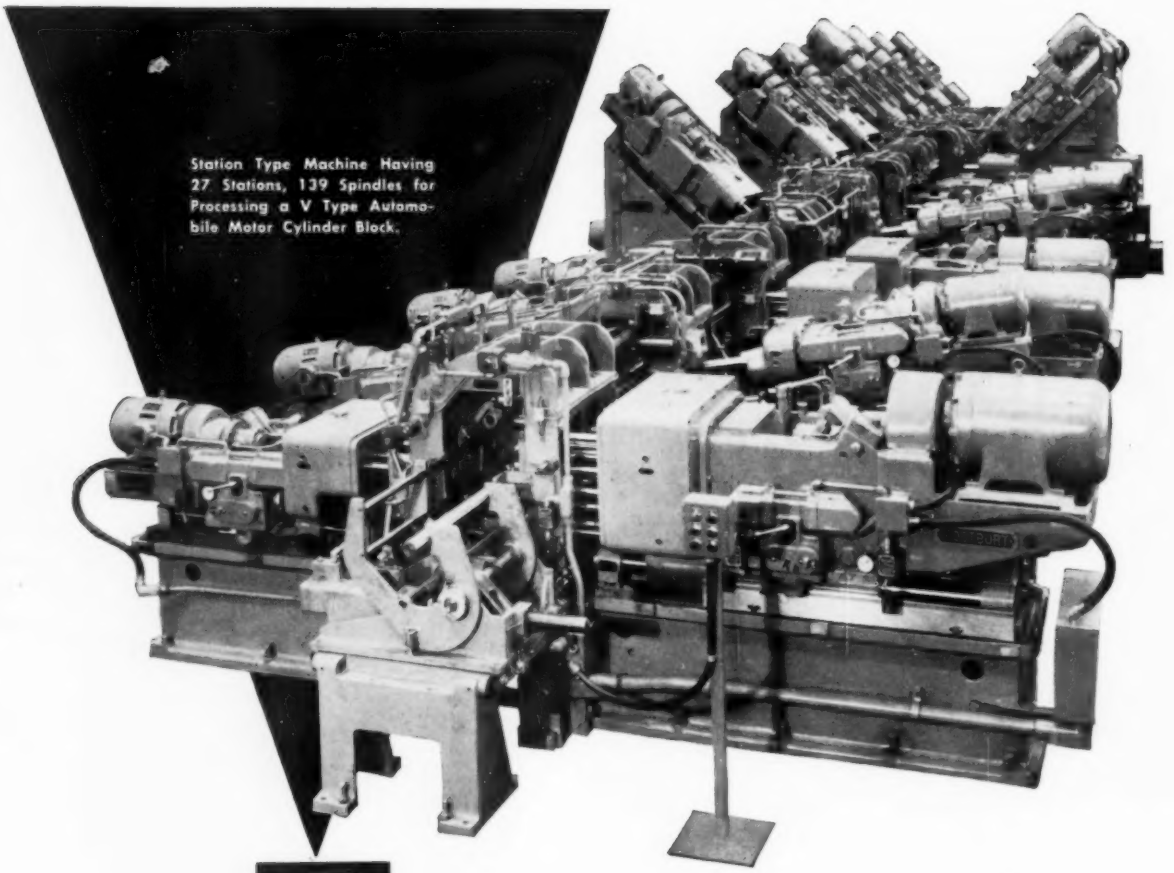
In ease of operation, accuracy, power and completeness, there is no finer grinder. Full details are at your DoALL Store—or write . . .

THIS IS A TYPICAL DoALL STORE

THE DoALL COMPANY, Des Plaines, Illinois GR-26

MACHINE TOOLS ..... CUTTING TOOLS ..... MEASURING INSTRUMENTS ..... SHOP SUPPLIES IN STOCK

TO OBTAIN FURTHER INFORMATION ABOUT ADVERTISERS, TRADE LITERATURE OR TOOLS OF TODAY APPEARING IN THIS ISSUE OF THE TOOL ENGINEER, USE THE HANDY READERS SERVICE CARD ON PAGE 139.



Station Type Machine Having 27 Stations, 139 Spindles for Processing a V Type Automobile Motor Cylinder Block.

FOOTBURT station type machines

PROGRESSIVE PRODUCTION . . .

With the Station Type Machine, Footburt continues to provide the most modern developments in production machinery.

Drilling, reaming, tapping, milling, checking and testing may be combined in one station type machine, and units may be mounted at any angle.

Installations of Footburt Station Type Machines have been made in many leading automotive plants, in some case handling the major machining on the block and head components.

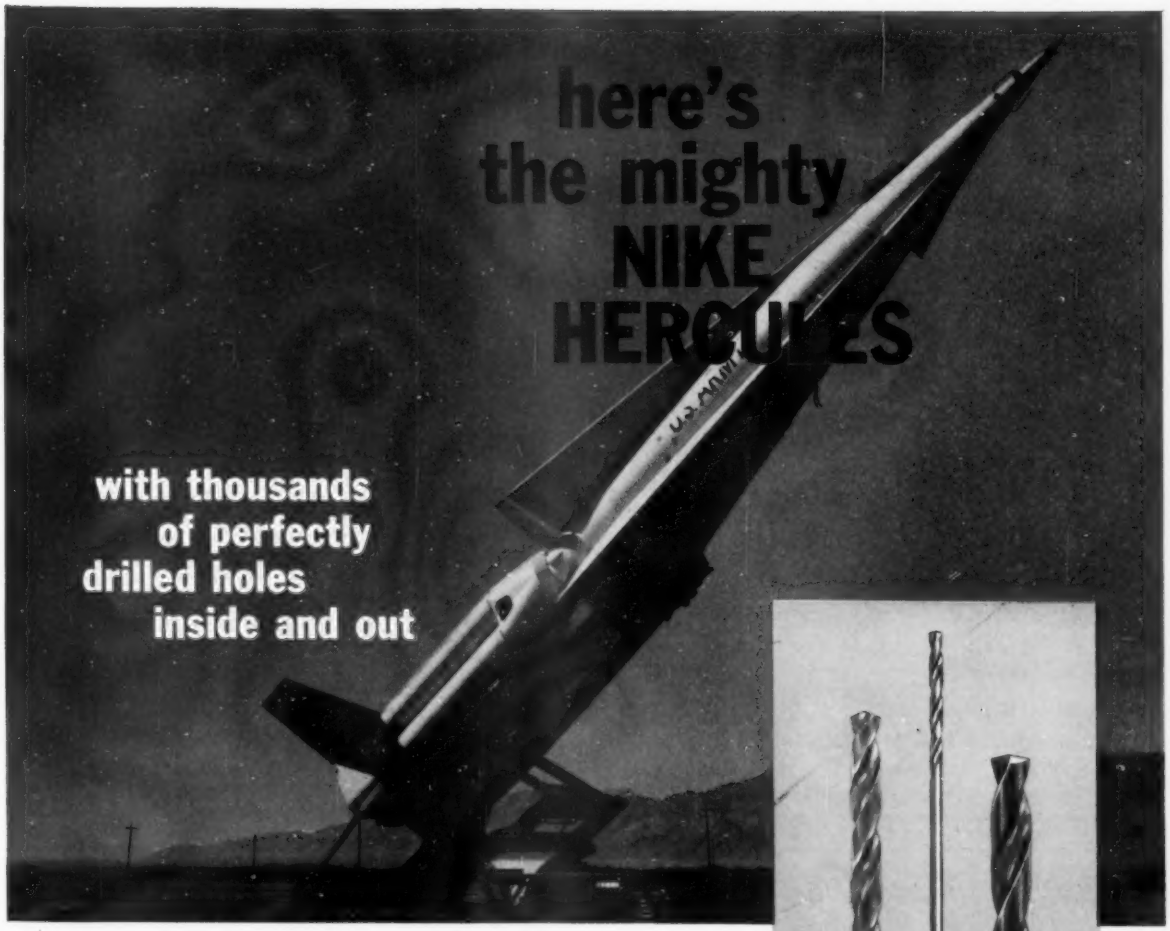
ENGINEERED FOR PRODUCTION

THE FOOTE-BURT COMPANY, Cleveland 8, Ohio

Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.

FOOTBURT

MACHINE TOOLS



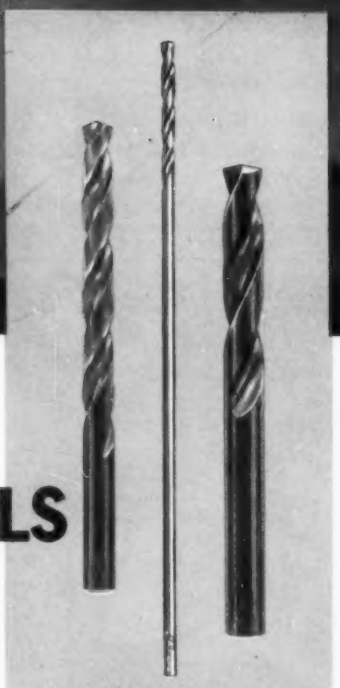
Clean, concentric holes without burrs...put there by

NEW YORK TWIST DRILLS

Capable of carrying a nuclear warhead that can knock out an entire aerial fleet with a single blast, Nike-Hercules is an advanced Army Ordnance surface-to-air missile produced by an Army-industry team that includes our long standing customers Western Electric Company – Bell Telephone Laboratories and Douglas Aircraft Company.

In the "hole" production of these powerful weapons they find NEW YORK TWIST DRILLS bite clean and fast into today's tougher alloys.

Industrial plants across the continent who make equipment in just about every category like the rugged qualities and accurate performance of NEW YORK drills—*and many users find they save at least 20% on cost at the same time.* If you have a drilling problem involving difficult alloys or unusual specifications, let us know about it. We'll be glad to discuss it with you and make recommendations.



Among the New York drills used in missile and aircraft manufacturing are aircraft extension drills, stack drills and drills for stainless steel, 75 ST aluminum, titanium, inconel X and other tough materials. We also feature Types A, B and C drills made to National Aircraft Standards specifications.

NEW YORK TWIST DRILL COMPANY, INC.
Eastern Headquarters: 278 Lafayette Street, New York 12, N. Y.
Midwest Headquarters: 30A North Clinton Street, Chicago 6, Ill.

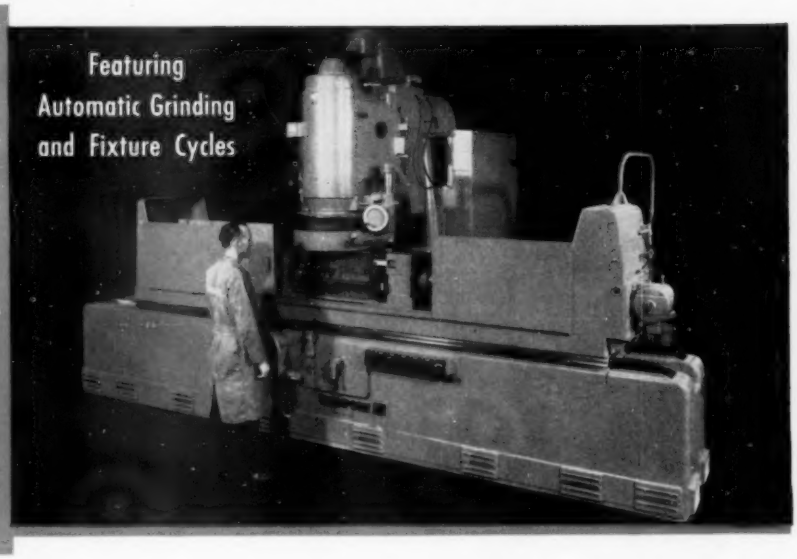
THOMPSON handles the toughest production jobs... *fast and accurately...*

with

THE VERTICAL SPINDLE SURFACE GRINDER

SPECIFICATIONS

Size: 18" x 18" x 62"
Wheel: 22" Segmental
Production: 30 blocks per hour
Total Stock Removal: .010"



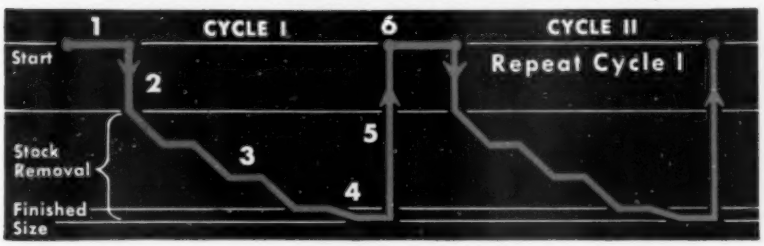
Shown above is the latest Thompson vertical spindle machine grinding the diesel engine cylinder blocks of a leading truck manufacturer. To meet the demand for fast, continuous production, both the fixture and grinding cycles are automatic and are interlocked to prevent accident. A separate hydraulic power source operates the single place fixture which locates the cylinder block on the main bearing holes.

Since any variations in stock removal would affect the compression ratio of the engines, constant accuracy is controlled throughout the grinding cycle. The operator merely sets wheel contact with the work and automatic operation begins.

Thompson vertical spindle surface grinders are made in various types and sizes to meet all job requirements. All machines of 40 inches and up in work length are equipped with the Hydra-Cool Hydraulic System*—the exclusive Thompson feature that eliminates all heat distortion throughout the machine.

*Pat. Applied For

MACHINE CYCLE (Total Stock Removal .010")



CYCLE I

1. Load work piece into fixture and start table cycle.
* 2. Manually lower grinding wheel to contact work piece.
3. Automatic downfeed of wheel occurs at each table reverse to remove .010" stock.
4. Spark out to final size with table moving to start position.
* 5. Manually elevate grinding wheel to starting position and release work piece in fixture.
6. Table automatically stops.

**Can be furnished as automatic functions.*

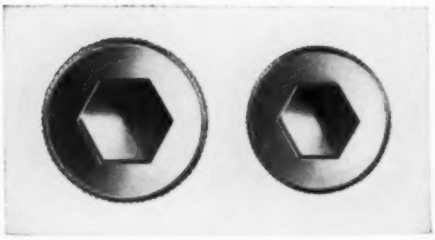
Thompson SURFACE GRINDERS

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

"Keep Thompson in mind for that daily grind"

NEW UNBRAKO socket cap screws with *pHd**

have design features that provide higher reliability in all sizes by increasing usable fastener strength as much as 134%



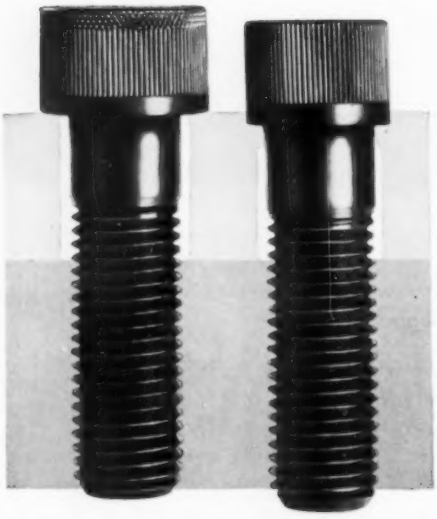


ILLUSTRATION COMPARES NEW UNBRAKO pHd cap screw (left) with same size screw of ordinary design. The larger head of the UNBRAKO pHd can carry much greater loads without indenting into the bolted material. This means greater clamping force and longer fastener life under dynamic loads. The larger socket in the UNBRAKO pHd makes possible greater repetitive tightening.

hiRf High Reliability factor

Research at SPS is realistic, for it faces the fact that industry is always seeking structural and mechanical components with increasingly higher standards of predictable performance. By installing SPS high reliability fasteners in your assemblies, you increase overall product reliability.

"High Reliability" is a booklet just published by SPS. Write for your copy today.

†T.M. Reg. U.S. Pat. Off., The Nylok Corporation

**pHd stands for "proper head design"—a factor in higher product reliability*

ADVANTAGES OF THE NEW UNBRAKO pHd SOCKET CAP SCREWS

- Heads are designed to carry greater loads. Diameters have been increased without changing heights.
- Miniaturization. Space and weight-saving design through use of smaller diameter or fewer screws. The 170,000-190,000 psi of these fasteners can be used to greater advantage.
- Reduction of fatigue failures. pHd allows consistently higher preloading, a major factor in lengthening the fatigue life of threaded fasteners.
- Fewer loosened threaded fasteners under shock or vibration.
- Elimination of washers under the heads of cap screws in many applications where they are used to increase the effective bearing area.
- Minimization of effects of oversized holes on the head-bearing area and resulting increase in holding power.

The bearing area surface of the new UNBRAKO pHd, enlarged to hold the bearing stress to 80% of the axial tensile load on the screw, increases the holding power of the screw by as much as 2⅓ times. The head diameter increase, a maximum of 17% in the larger sizes, increases usable fastener strength as much as 134%. This means greater clamping force and longer fastener life under dynamic loads in tension applications. The head diameters, enlarged on 5/16, 7/16, 9/16, ⅝, ¾, ⅞ and 1 in. body diameters, also prevent the screw head from indenting the material being assembled—a fault that normally reduces, and sometimes even dissipates, the vital preload or tensile stretch that keeps the screw tight and prevents fatigue failures. The larger head diameter also provides room for a bigger wrenching socket where required and this, in turn, makes tightening to designed preload easier and more certain.

The new UNBRAKO pHd socket cap screws are now available through authorized industrial distributors at no increase in prices. Specify them when ordering. Also available with Nylok† self-locking feature. For technical data and specifications, send for Bulletin 2406. Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 37, Pa.

COMPARISON OF UNBRAKO pHd AND CONVENTIONAL DESIGN

Each size can now be utilized with equal reliability. The bearing stress is consistent from size to size in the new UNBRAKO pHd socket cap screws.

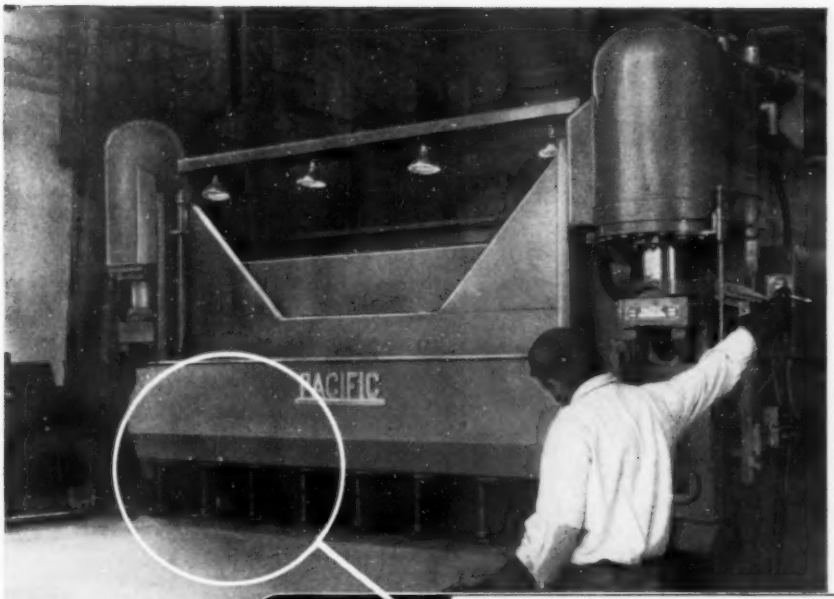
SCREW SIZE	HEAD DIAMETER (in.)		BEARING AREA (sq. in.)		LOAD TO INDENT IN CAST IRON (lb.)		% INCREASE USABLE STRENGTH	TIGHTENING TORQUE (lb.-in.)‡	
	Old	pHd	Old	pHd	Old	pHd		Old	pHd
¼	.375	.375	.041	.041	3,280	3,280	—	165	180
5/16	.438	.468	.047	.072	3,760	5,760	54	325	360
⅜	.562	.562	.102	.102	8,150	8,150	—	600	660
7/16	.625	.656	.116	.148	9,270	11,800	27	1,000	1,040
½	.750	.750	.188	.188	15,000	15,000	—	1,450	1,590
9/16	.812	.843	.209	.247	16,700	19,700	18	2,050	2,270
⅝	.875	.937	.203	.305	16,200	24,400	51	2,900	3,190
¾	1.000	1.125	.223	.432	17,800	34,600	94	5,050	5,600
⅞	1.125	1.312	.254	.594	20,300	47,500	134	8,000	8,900
1	1.312	1.500	.364	.785	29,100	62,800	116	10,550	13,600

‡Normal recommended seating torques for unplated screws, fine threads

We also manufacture precision titanium fasteners / write for free booklet

SPS **Jenkintown • Pennsylvania**

Standard Pressed Steel Co. • The Cleveland Cap Screw Co. • Columbia Steel Equipment Co. • National Machine Products Co. • Nutt-Shel Co. • SPS Western • Standco Canada Ltd. • Unbrako Socket Screw Co., Ltd.

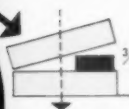


Adjusting Pacific rake angle by hand control lever

NOW...

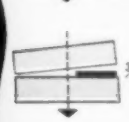
a ½" shear adjustable to cut full length ¾" plate continuously*

SEE HOW RAKE ANGLE OF PACIFIC HYDRAULIC SHEAR IS CHANGED FOR PERFECT SHEARING OF ANY THICKNESS OF METAL



By increasing rake angle to ¾" per foot the shear can cut ¾" steel plate with the force normally required to cut ½" plate. A conventional shear would be permanently damaged by overload if this were attempted.

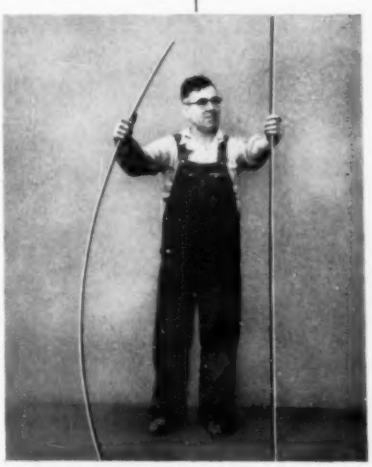
In cutting rated capacity (½"), shear cuts exactly the same as conventional fixed rake angle shear.



In cutting 3/16" steel, the rake angle is reduced to 3/32" per foot and the shear will cut strips 24" long up to 60 per minute with less twist and bow than with any conventional shear.

Rugged Pacific Hydraulic Shear cuts steel from 20 gauge to ¾" plate with optimum knife clearance. The knife clearance can be adjusted in 30 seconds to match plate thickness. Pacific Hydraulic Shear cuts noiselessly without shock. Knives last 2 to 3 times longer . . . maintenance downtime from blade changing is greatly reduced. Pacific Hydraulic is the safest shear. The ram, controlled by a portable foot pedal, can be stopped instantly at any point throughout the stroke in an emergency. Pacific Hydraulic cannot be damaged by overload. Independent time studies confirm that it will equal or out-produce any mechanical shear.

* with optimum knife clearance.



ABOVE, RIGHT: *¼" plate cut with Pacific adjustable rake shear*

ABOVE, LEFT: *¼" plate cut with conventional shear*

PACIFIC HYDRAULIC SHEAR

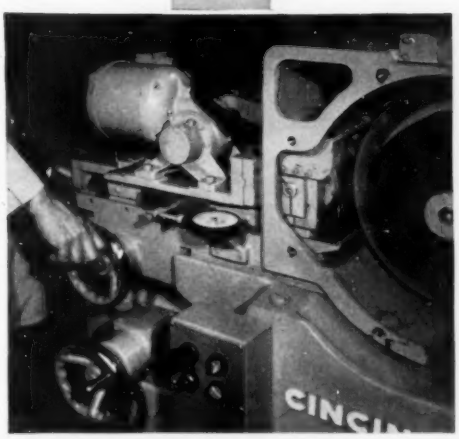
Mfg. by
PACIFIC INDUSTRIAL MFG. CO.
848 49th Ave., Oakland, Calif.
Plants: Oakland, Calif. and Mt. Carmel, Ill.

DISTRIBUTORS:
LOS ANGELES—Tornquist Machinery Co. • PORTLAND—Portland Machinery Co. • SEATTLE—Buckner Weatherby Co. • SALT LAKE CITY—Todd Machinery Co. • DENVER—R. E. Duboc Associates • HOUSTON—Butcher, Carter & Preston Co. • DALLAS—Machine Tool Associates • TULSA—Martin Machinery Co. • KANSAS CITY, DES MOINES & ST. LOUIS—Moehlenpah Engr. Co. • NEW ORLEANS—Dixie Mill Supply Co. • NORFOLK—Tidewater Supply Co. • PITTSBURGH—Steel City Tool & Machinery Co. • CLEVELAND—Wigglesworth Machinery Distributors • INDIANA—Harry B. Green Machinery Co. • CHICAGO—The Gute Co. • MILWAUKEE—The Gute Co. • DETROIT—Taylor-Thompson Machinery Co. • MINNEAPOLIS—The Gute Co. • LOUISVILLE—Harry B. Green Machinery Co. • ALBUQUERQUE—R. E. Duboc Associates • WYNNEWOOD, PA.—Edward A. Lynch Machinery Co. • MT. VERNON, N. Y.—William Halpern & Co., Inc. • WETHERSFIELD, CONN.—Beisel Machinery Co. • TORONTO—Hercules Presses, Ltd.

New Cincinnati Filmatic No. 1

CINCINNATI FILMATIC No. 1 Centerless Grinding Machine, with Crush Truing Attachment and Electro-Hydraulic Automatic Infeed Attachment. Catalog No. G-703.

Top Performer in Centerless Grinding Small Parts, *including Accurate Form Work requiring Crush Trued Wheels*



Crush truing unit, with cover removed. Crushing rolls are cartridge mounted for setup convenience. Motor mounted on the bracket drives the rolls for regrinding them, while an auxiliary motor supplies the slow speed required for effective wheel crushing. Diamond wheel truing unit is mounted on top of wheel guard.

Everyone concerned with quality and costs will be delighted with the performance of new CINCINNATI FILMATIC No. 1 Centerless Grinding Machines. They are built for precision infeed and thrufeed work, and can be equipped with a variety of production attachments, **including crush truing.** Highlights of design and how they contribute to top performance include:

Exclusive FILMATIC grinding wheel spindle bearings... over 99% of these bearings on all CINCINNATI Grinding Machines have never required service

Swivel mounted regulating wheel unit . . . reduces setup time

Automatic and oil shot lubrication

Engineered electrical controls . . . enclosed and protected from damage and tampering

In addition, Cincinnati has a selection of 19 attachments, such as graduated axial spindle adjustment, Electro-Hydraulic automatic infeed, grinding wheel spindle reciprocation, crush truing, and others. ¶Your centerless grinding equipment for work within 1½" diameter range can now be profitably replaced with new CINCINNATI No. 1's. Our Engineering Service Specialists, the world's most experienced in tooling up centerless grinders, are ready to help. Get a good start by asking for catalog No. G-703.

CINCINNATI GRINDERS INCORPORATED
CINCINNATI 9, OHIO

CINCINNATI®

CENTERTYPE GRINDING MACHINES • MICRO-CENTRIC GRINDING MACHINES
CENTERLESS GRINDING MACHINES • ROLL GRINDING MACHINES • SURFACE
GRINDING MACHINES • CHUCKING GRINDERS • CENTERLESS LAPPING MACHINES

TOOLING FOR THE SPACE AGE!

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SHRINE EXPOSITION HALL
LOS ANGELES—SEPT. 29-OCT. 3

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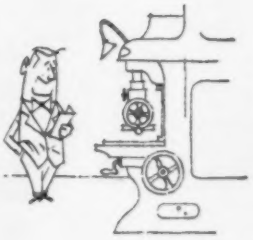
AMERICAN SOCIETY OF TOOL ENGINEERS
10700 PURITAN AVE.
DETROIT 38, MICH.

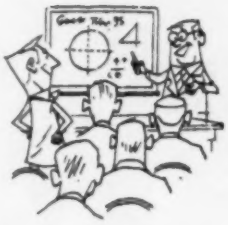
AMERICAN SOCIETY OF TOOL ENGINEERS
TOOL SHOW CONFERENCE '58 SEPT 29 - OCT 3

SEE everything that's new in tooling and production equipment.

All the very latest advances and improvements in more than thirty basic categories of industrial products will be on display. It's your chance to see tooling's future, *your* future at one time under one roof. Don't miss it! Plan *now* to attend the West's most outstanding industrial event.



ATTEND fact-packed technical conferences, symposia and panels.



Fifteen major symposia and panels . . . conducted by eminent authorities . . . will be devoted to subjects of vital interest, including: Tooling Space Airframes; Sandwich Construction for Aircraft; Forming the Exotic Metals; Tooling for Electronics; Numerical Control in Missile Production; Plastics in Tooling.

MEET the men who make the wheels of Western industry go 'round.

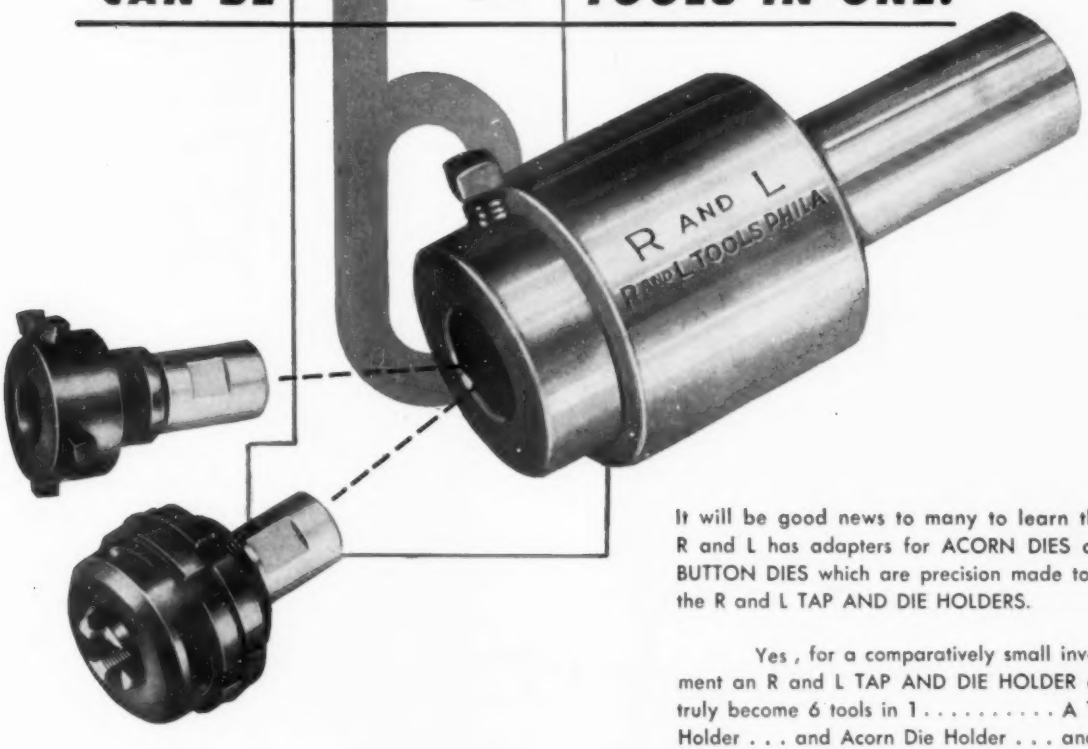
What better opportunity to meet and exchange ideas with management, engineering, design, production and industrial sales people? And what could be more important, in today's highly competitive market, than to be informed and up-to-date on all the latest production developments?

INSPECT some of the finest plants in the Los Angeles Area.

You'll see industry in action, too. Plant tours scheduled include: Byron Jackson Tool Co.; Douglas Aircraft Co.; Long Beach Naval Shipyard; Crown Zellerbach Corp.; Consolidated Electrodynamics; Hughes Products Div., Hughes Aircraft; United States Electrical Motors; American Can Co.; Mercury Div., Ford Motor Co.; Lever Bros. Co.; Northrop Aircraft Co.

THE RIGHT R and L LEFT TAP AND DIE HOLDER

CAN BE 6 TOOLS IN ONE!



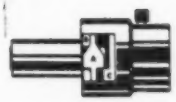


Figure 1.
Ready to start threading operation, clutch slightly engaged at C.

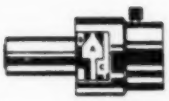


Figure 2.
Instantly engaged to full contact between A and C as soon as tap or die engages work.

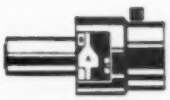


Figure 3
Fully released showing ample clearance between contact points of clutch preventing re-engagement or hammering of clutch points in case turret advances slightly after clutch releases.

• By substituting a shorter clutch ring retaining nut this tool can be readily changed for cutting extra short threads.

It will be good news to many to learn that R and L has adapters for ACORN DIES and BUTTON DIES which are precision made to fit the R and L TAP AND DIE HOLDERS.

Yes, for a comparatively small investment an R and L TAP AND DIE HOLDER can truly become 6 tools in 1 . . . . . A Tap Holder . . . and Acorn Die Holder . . . and a Button Die Holder . . . *For right and left hand threading* and tapping.

LEST YOU FORGET . . .
. . . The R and L TAP AND DIE HOLDER has an entirely new releasing mechanism, and can readily be changed for right or left hand threading and tapping. No spring plungers to wear or break. No small screws to work loose.

Write for NEW catalog

R and L TOOLS TE-7
1825 BRISTOL ST., PHILADELPHIA 40, PA.

☐ Please send me your new catalog
☐ Please arrange for no-obligation demonstration of R and L TOOLS

NAME .....
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RIGHT R and L LEFT **TOOLS**
1825 BRISTOL STREET • PHILADELPHIA 40, PA.

OTHER FAMOUS R and L TOOLS:

TURNING TOOL • COMBINATION SWING TOOL • CARBIDE OR ROLLER BACKRESTS RELEASING OR NON-RELEASING TAP AND DIE HOLDERS, (ALSO FURNISHED FOR ACORN DIES) • UNIVERSAL TOOL POST • CUT-OFF BLADE HOLDER • RECESSING TOOL REVOLVING STOCK STOP • FLOATING DRILL HOLDER • KNURLING TOOL

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Aircraft part formerly hand-finished to remove burrs and sharp corners. Hand-finishing time: 15 minutes.

AFTER BRUSHING

Burrs are efficiently removed, edges and surface junctures are precision blended to microinch tolerances. Osborn Power Brush Finishing time: 3 minutes.

5 times as fast

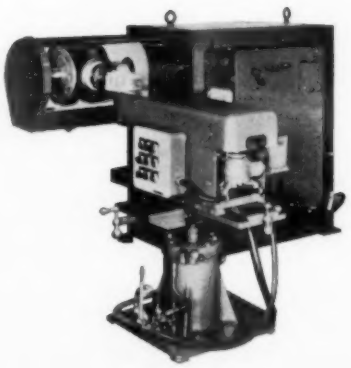
OSBORN Brushamatic® saves 180 hours a month

ALL edges and surface junctures of this aircraft component must be blended to microinch specifications to eliminate stress concentrations and ultimate fatigue cracks.

Previously, this surface blending had to be done by hand . . . requiring considerable skill and time. Still, results were inconsistent . . . rejects were high, calling for reworking and re-inspection.

Using Osborn's Brushamatic® Machine, the operation that once took 15 minutes is now done in 3 minutes . . . a 400% *increase in output per man—and a saving of 180 hours a month.*

This kind of precision finishing can save money on many types of products you manufacture today. An **O**sborn **B**rushing **A**nalysis, made in your plant, will show you how. Write us for details—and for your copy of the 100-page Osborn Catalog 210-C . . . and for the 20-page Brushamatic® booklet. *The Osborn Manufacturing Company, Dept.* K-48, *Cleveland 14, Ohio.*



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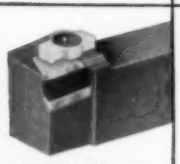
Osborn Brushes

BRUSHING MACHINES • BRUSHING METHODS • INDUSTRIAL BRUSHES • FOUNDRY PRODUCTION MACHINERY

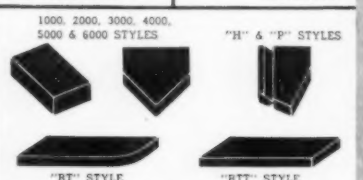
Caterpillar REG. U.S. PAT. OFF. Tractor Co. gets results . . . with Talide S-92

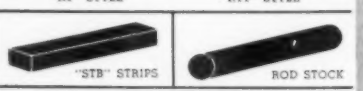

BRAZED

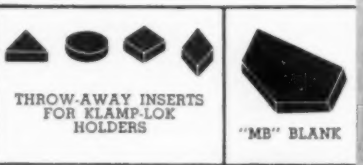

VERTICAL CLAMPED

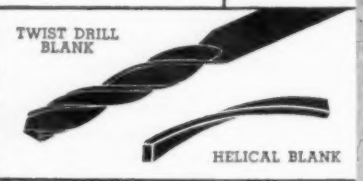

"THROW-AWAY"

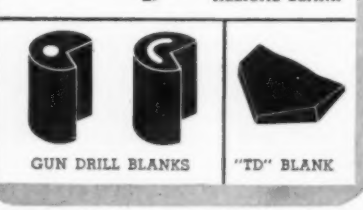

HORIZONTAL CLAMPED

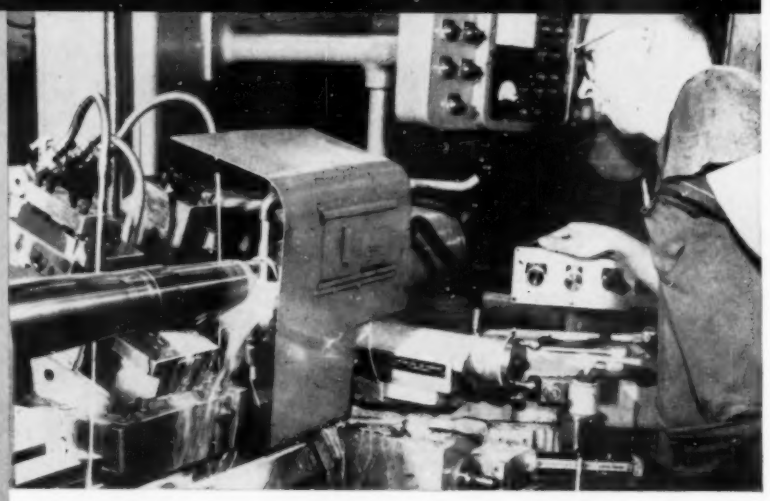




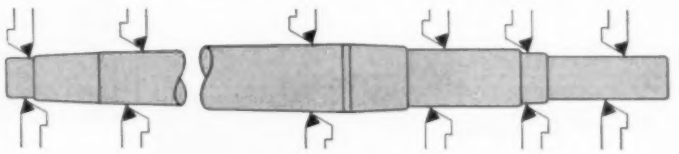








Caterpillar REG. U.S. PAT. OFF. Tractor Co., leading producer of tractors, diesel engines, motor graders and earthmoving equipment, has been using cost-cutting TALIDE tools for over 10 years to produce parts. Typical example of savings obtained is illustrated below:



CRAWLER TRACTOR AXLE SHAFT

Part . . . . . Crawler Tractor Axle Shaft

Material . . . . . SAE 8645 Steel Forging 3¼" dia. x 38½" long, 3.6mm Brinell Hardness.

Operation . . . . Rough turn all diameters, form tapers, shoulders, and steps.

Machine . . . . . Monarch Mona-Matic No. 21 Tracer Lather, size 54".

Tools . . . . . 12 Talide TB-164 ½" I.C. Triangular TALIDE Throw-Away Inserts mounted in Klamp-Lok Toolholders, Grade S-92.

Depth of Cut . . ⅜"

Feed . . . . . 6" per min.—.018 F.P.R.

Speed . . . . . S.F.M. 387—R.P.M. 340

Coolant . . . . . Soluble Oil and Water

Results . . . . . TALIDE Grade S-92 turned 7 shafts per corner per grind for total of 42 shafts per grind. Inserts were ground an average of 6 times and produced a total of 294 shafts over life of insert. Next best premium carbide grade produced 235 shafts.

Call in a Talide sales engineer to recommend proper tooling for your machining operations, or write for 76-page catalog No. 57-G. METAL CARBIDES CORPORATION, 6001 Southern Blvd., Youngstown 12, Ohio.

CONSTANT RESEARCH PAYS OFF!

Year after year Talide metal improves in hardness, strength, rupture resistance and crater resistance properties. Processed in latest type vacuum electric furnaces under rigid laboratory control—all Talide grades are uniform and consistent in quality.

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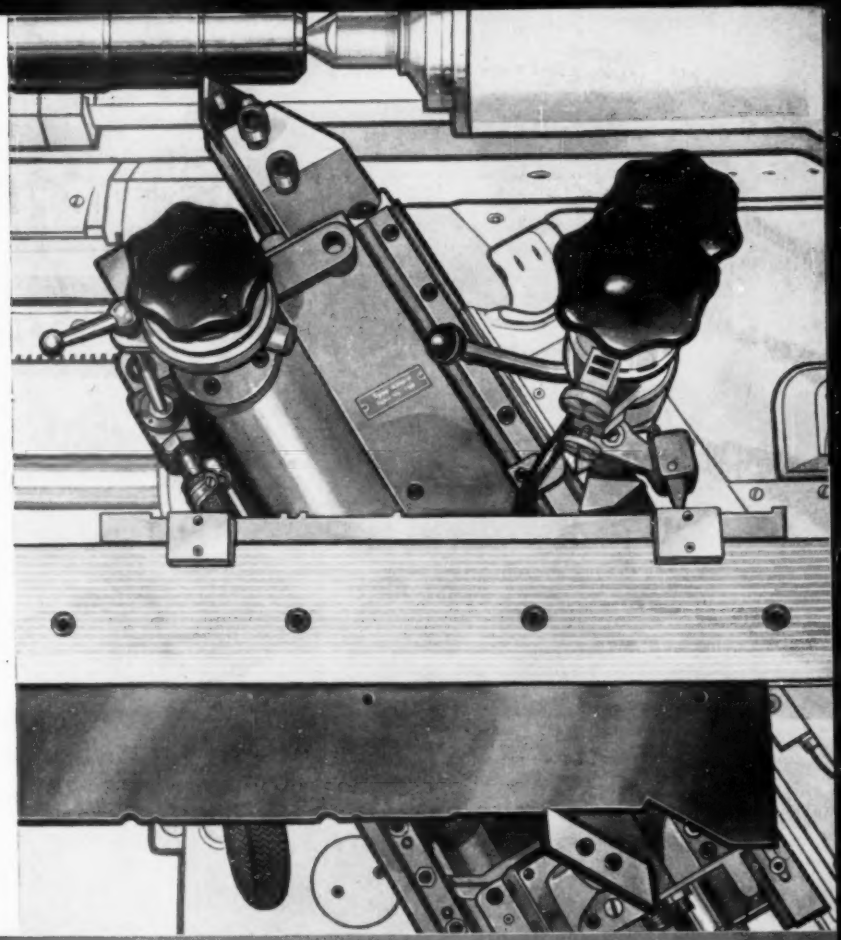
HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

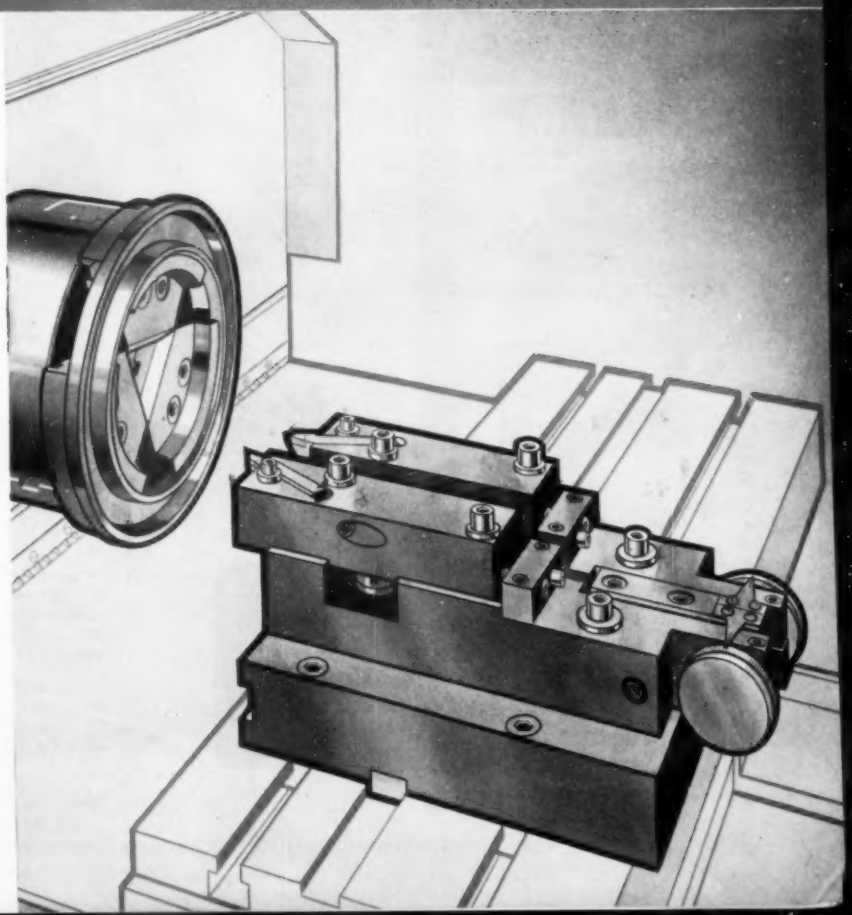
Look at
Single Point Tooling on
New Britain +GF+

Outproduces gang tooling setups by reducing tool change time practically to zero, and by cutting at maximum speeds and feeds for tool efficiency.

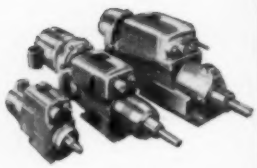


Look at New Britain's
simple approach to problem pieces

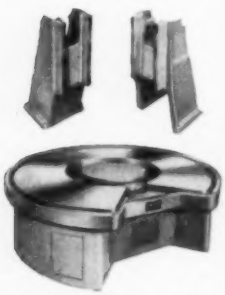
Low cost per piece is inherent in New Britain Precision Boring Machines because of their simplicity, versatility, speed, repetitive accuracy and inexpensive tooling. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



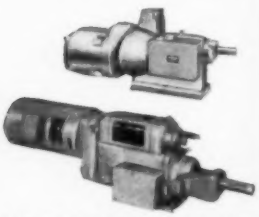
THE COST CUTTING METHODS you need AT A PRICE you can afford



Air Hydraulic Drill Units



Circular Machine Base and Columns



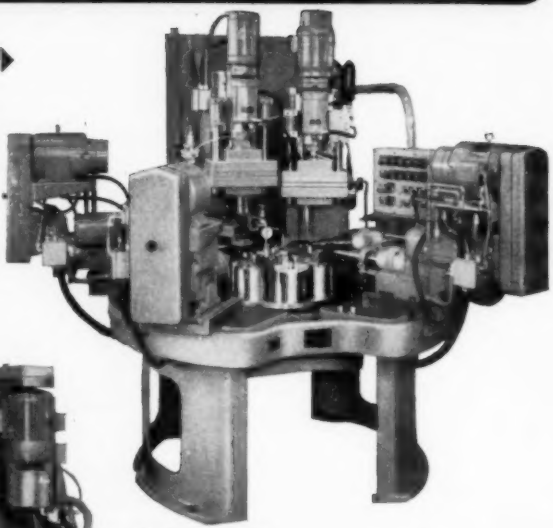
Automatic Lead Screw Tapping Units

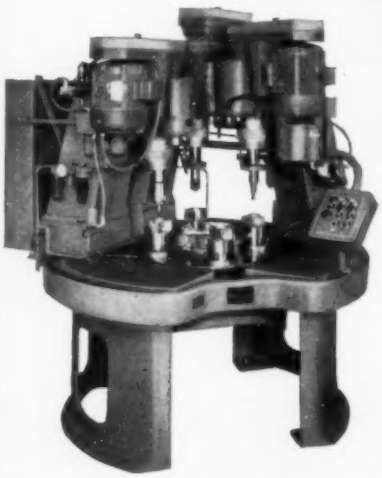
Rectangular Machine Base

EXAMPLE* ▶

A high speed indexing machine to drill and lead screw tap horizontal opposed pipe ports and two vertical mounting holes in stainless steel valve bodies at 320 parts per hour. Standard automatic self-centering Skinner air chucks hold parts.

Photo courtesy of The Skinner Chuck Company

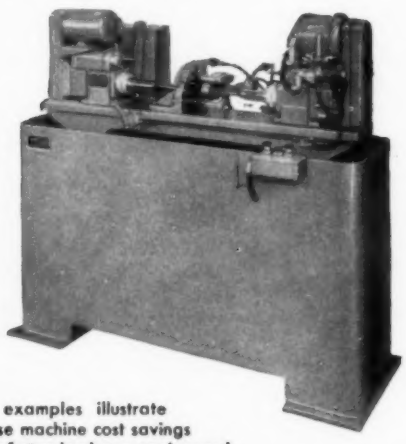




◀ **EXAMPLE***

Combination drill, bore and face plus two tapping operations in die cast regulator valve spring cages. Capacity: 450 parts per hour.

Photo courtesy of Watts Regulator Company



EXAMPLE* ▶

Double end opposed combination ream and face die cast piston plates to close tolerance. Simplified air-manual fixture loading permits production of 423 parts per hour.

Photo courtesy of Bendix Products Division Bendix Aviation Corporation

***Note**

The above examples illustrate single-purpose machine cost savings through use of standard pre-engineered components. The components, bases, columns, adapters and units as shown, are available for machines built by you or for you from Hartford Special.

Write today for full information and name of our nearest field man—a specialist in low cost production techniques.

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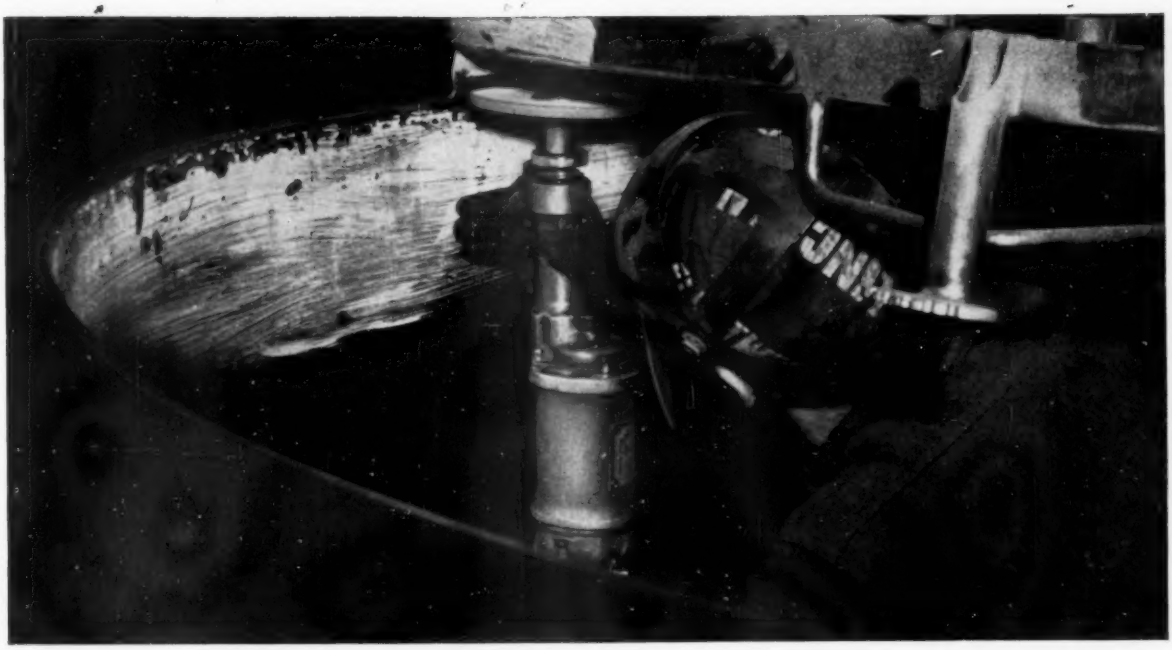

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Index of THE TOOL ENGINEER Advertisers

July 1958

The Index to Advertisers is published as a reader service. Although every precaution is taken to assure correct listing, no allowance will be made for error or omission.

*Exhibitor in 1958 ASTE Industrial Exposition

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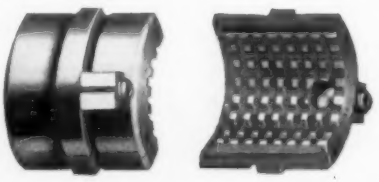

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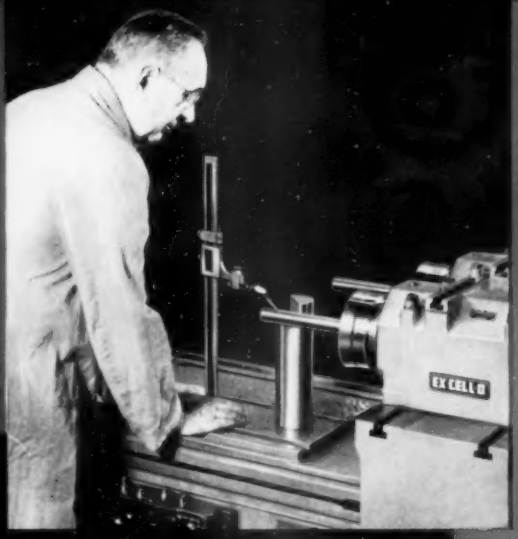

The same skill, care and precision that goes into the building of a new machine is duplicated in renewal or repair of older machines by the men who know Ex-Cell-O Precision Machines best.

58-39

Are you ready for the business upsurge?

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Ex-Cell-O's facilities for machine repair or renewal are geared to your specific needs—whether it's a planned modernization program or an emergency repair job. The service is fast, the workmanship thorough; and, of course, necessary replacements are Ex-Cell-O "original equipment" precision parts.

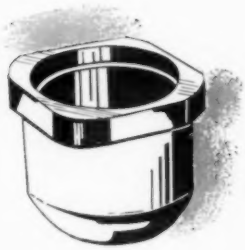
For complete satisfaction and guaranteed results, put your Ex-Cell-O machines in the hands of the men who know them best. Contact your local Ex-Cell-O Representative, or call direct for complete details.

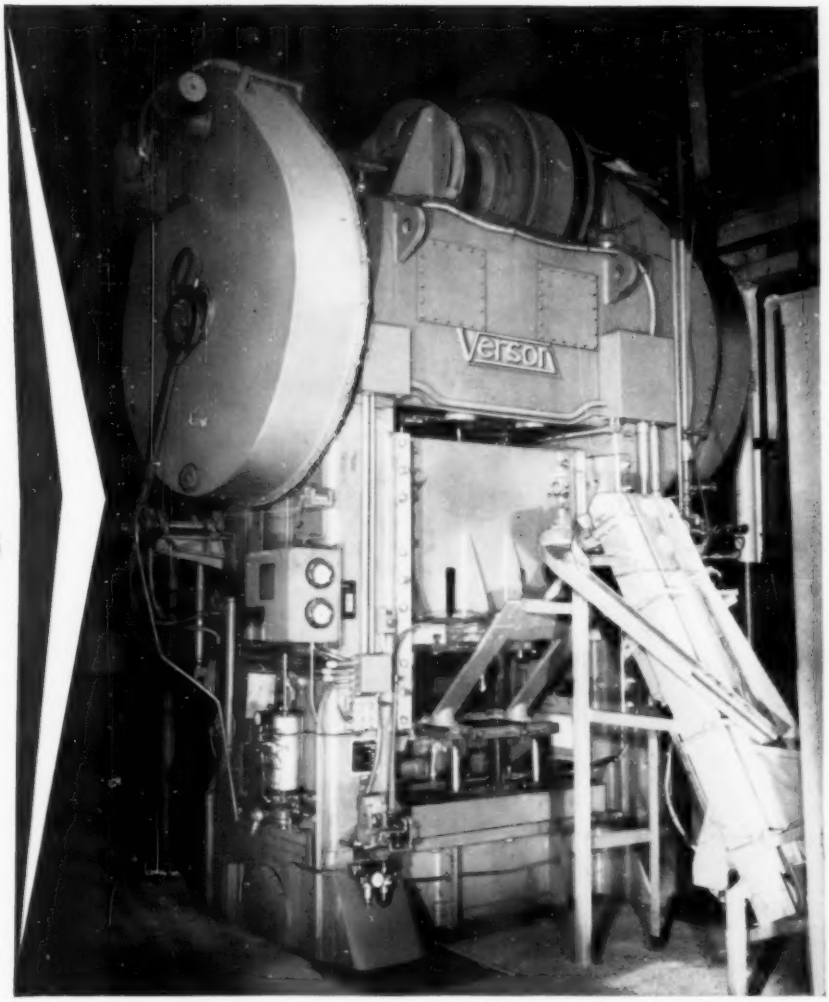
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

VERSON

PRESSES help produce ball joint suspension housings for complete line of automobiles





Six Verson Presses are important components of a unique production line recently installed at a plant of a major automotive manufacturer. The entire setup is devoted to producing upper and lower housings for ball joint suspension systems on a complete line of automobiles.

Shown above is the cupping press which handles the first forming operation on material previously blanked and ground from strip stock. This press processes two sizes of blanks which ultimately become two sizes of upper and lower ball joint housings.

Press capacity is 200 tons; stroke is 10"; operating speed, 30 SPM. Two parts are produced per stroke. Feeding of blanks and discharging of finished form cups is completely automatic. The feed unit orients and feeds the blank. The die unit is constructed with safety circuits which shut down the equipment in the event of tool failure or misfeeding of blanks.

Whether your requirements call for a single press or a fully automated press line, Verson engineers can show you how Verson Presses can do the best job at lowest cost.

186-C

A Verson Press for every job from 60 tons up.

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